ENGINEERING NEWS

SOME very interesting tests were made this week at the Pittsburg Steel-Casting Co.'s works of the steel car-wheels, which they are said to have succeeded in making. The wheels are cast on a newly invented method. While the metal is cooling, the molds are put in motion, rotating swiftly, adding strength to the outer edge of the wheel. The wheels are said to have the advantage of great strength and durability, while made much lighter than even the paper-wheel. The price will be placed at 4 cts. per lb. This makes them a little more expensive than cast-iron wheels, but they are still very much cheaper than either paper or steel built wheels. After the wheels are cast, they are reheated and rolled out on the tread and flange until they are perfectly round, in order to harden the wearing surface, and make the wear on the rails and springs less. The test required by the Pennsylvania Railroad for their wheels is five drops of 140-lb. weights at 12 ft. One of the new steel wheels was this week subjected to a test of this character. The drop was a distance of 12 ft, and as follows:—First, 40 drops of 163 lbs.; second, 10 drops of 217 lbs., and third, 3 drops of 280 lbs. At the fifty-third blow, with the drop of 280 lbs., the wheel cracked. The test was then continued, 10 drops of 163 lbs. and 11 drops of 280 lbs. At the seventy-fourth drop the wheel broke. These figures show plainly the great strength of the wheel.

THE very important news is announced that the South Pennsylvania magnates have adjusted their differences, completed their plans, and will push the road to completion as soon as spring opens. Mr. ANDREW CARNEGIE is credited with the work of setting the enterprise again in motion. The stockholders agree to an assessment of 20 per cent., by which $3,000,000 will be raised. $7,000,000 has been already spent in construction. The company will then issue $1,000,000 of bonds which are sure of a ready sale, probably at a premium. The traffic agreements with the Reading, Jersey Central, Pittsburgh & Lake Erie and Pittsburgh, McKeesport & Youghiogheny are still in force and the road will be in a position to do a good business from the start. The Edgar Thomson Steel Works will furnish the rails for the road. It is not stated how the legal obstacles which the Pennsylvania Railroad Company has laid in the way of the enterprise are to be got around. But it is certainly true that the long hitch in the construction of the road has been due fully as much to the dissensions among its owners as to the opposition of its rival.

The announcement had a depressing effect upon the Stock Exchange as it supposed that the opening of the road is likely to be conducive to anything but peace among the trunk lines. It would seem, however, that the Pennsylvania and Vanderbilt systems will not be foolish enough to engage in any prolonged struggle, and when so much capital has been invested in the construction of a line of such evident usefulness as the South Pennsylvania, it is far better to complete the road and put it in operation even if it pays but a small interest on its first cost, than it is to allow the capital already sunk in it to be a total loss from the world's wealth.

THERE has not been for a very long time such a wholesale slaughter of rates as is now going on in all parts of the West. The blame is generally laid upon the new Minneapolis, Sault Ste. Marie & Atlantic and that perennial thorn in the flesh, the STICKNEY system. The truth seems to be, however, that the lack of harmony among the old roads is the most fruitful cause of the war. At any rate the companies are all entering into the fight with a vigor and fierceness which betokens some precious small returns to stockholders this year, unless indeed the extremes to which the cut rates are running, forces an early settlement of the difficulties, which is not unlikely. Passenger rates have not yet been meddled with very much, but freight of all classes is being carried around the country at rates which can hardly pay for the wear and tear of conscience required to make them. The Northwest roads are the worst involved at present, but indications seem to point to a slowly brewing rivalry between the Santa Fé and Gould systems, which when it once gets under full headway is likely to be a long time in reaching a termination.

WHETHER because they have too much work at home, or from a lack of enterprise in this direction that is not usual in American business generally our capitalists and contractors fight shy of the late call of the Brazilian Government for bids on the harbor work at Pernambuco. Pernambuco is a prosperous city of 100,000 inhabitants, a little north east of Rio Janeiro. The work to be done is dredging and the utilization of the material in filling in ground and making temporary wharves; the construction of a breakwater, and an exterior dyke; the building up of ledges and cutting down of rocks and the construction of permanent wharves. The work must be commenced within one year from date of contract; $10,000 must be deposited with the proposal, either in the national treasury, in London or at the Brazilian legation, and this will be raised to $40,000 for the preferred bidder within 60 days of the acceptance of his proposal. No bids have so far been received from Americans, and it is expected that English or French capital will do the work.

THE following bridge accidents are reported: On Jan. 28 the bridge of the Texas, Santa Fé & Northern Railway, near Espanola, N. M., was burned. It was 206 ft. long and 45 ft. high. Incendiary work is suspected.——On Feb. 1 the Tabo bridge on the Lexington & Jefferson City extension of the Missouri Pacific Railway, near Lexington, Mo., was wrecked by the ice in Tabo creek breaking away the trestle work.——On Feb. 1 a girder of the Sixth street bridge over the Arkansas river, at Pueblo, Col., broke under a load of 20,000 lbs. of horseshoes, the bridge settling about 4 ft.

SERIOUS landslides have occurred over about 100 miles of the recently completed Oregon & California Railway. According to newspaper reports the slope of the cuts was too steep, and when the ground became soaked with melted snow it slipped down on to the track, covering it deep with earth and rock. Several hundred men are at work removing the material.——Washouts have occurred on the Southern Pacific Railway in California. Also on the Long Island Railway. Rain and melted snow have caused freshets in the Catskill region.

THE Spanish Government invites proposals for building and equipping a system of railways in the Island of Puerto Rico. Specifications and conditions of the proposal can be seen at the office of the Consulate General of Spain, 30 Broadway, New York City. The award of the contract will be made at the Government House, Puerto Rico, on March 5.

THE most serious railway accident of the week was another splitting of a fast passenger train on a facing point switch turning out from the outside of a slight curve, at Steamburg, on the New York, Penna. & Ohio Railroad. The engine and three coaches passed all right. The rear car, a Pullman sleeper, in some way got on the wrong side of the point, and crashed into the rear of a freight train on the siding, killing 2 of the freight train crew and 2 passengers, and injuring 8 others. We presume the switch was a split switch. No facing point switch can ever be made absolutely secure against this class of accident, until a new form is invented.

THE experiment of burning brick with oil is being continued in the West. The latest process is said to be devised by D. Y. PURINGTON, at his kilns, near Blue Island, Ill. To burn a kiln of 200,000 bricks he uses the crude, or waste oil, after the naphtha has been extracted. This oil is fed from a tank by a 2-in. pipe to very simple burners in the arches. The burning was complete in 60 hours. The oil cost 80 cts. per barrel, but the quantity used is not stated. One man only was required to handle the fuel and the saving over the old method is estimated at "fully 33⅓ per cent."

THE Chicago *Tribune* reports that the Union Steel Company has decided, after February 1, to use crude petroleum for fuel on a large scale. The oil will be used to fire 36 large boilers; it will be fed by gravity from tanks and applied in a spray in connection with a steam-jet. A system of brick work will protect the boilers, to avoid a repetition of the trouble experienced at the Chicago water-works, where an experiment with oil fuel resulted in the burning of the boilers.

THE Chester Rolling Mill, at Thurlow, Pa., have been successfully using the Cyclone Pulverizer, of Mr. ERASTUS WIMAN, for reducing coal to an impalpable powder as a fuel for a puddling furnace. This dust was fed from two 5-in. tubes into the furnace under an air-pressure of from 3 to 5 lbs. from a Sturtevant blower. In a late experiment in reducing two charges of pig-iron of 1,050 lbs. each, it is claimed that by weight it required only half the amount of pulverized fuel as compared with ordinary coal. The advantages claimed are—the saving of 40 to 60 per cent in fuel; saving of grate-bars; using culm instead of lump coal, and a better product from the iron.

A STONE embankment, constituting an extension of a dam at Glen Cove, erected 23 years ago, was carried away on Feb. 5 by the combined effect of ice and freshet, doing no great damage. The dam itself, which is some 20 ft. higher, stood all right, furnishing another instance of a common tendency in such work, to make the main part of the structure more secure than the lower and apparently less dangerous parts.

JOHN BOGART, State Engineer; THOS. C. CLARKE, Mem. Am. Soc. C. E., and RICHARD M. UPJOHN, Architect, have made a preliminary report to the New York Assembly, regarding the stone ceiling of the Assembly room. They state that it is in a very dangerous condition, with the ribs and arch-stones badly shattered and liable to give way at any time. They advise the immediate abandonment of the rooms below it and the taking down of this ceiling at once. They defer the details of their examination into the cause and its effect for a later report.

THE official report on the railways of South Australia for 1886-87, show net earnings for the year of 2.52 per cent. on a capital cost of construction of £9,083,093. To June, 1887, 1,419 miles of road were opened to traffic and 353 miles were under construction. The expenditures were 64.23 per cent. of the gross revenue. The average charges are not excessive as these amount to 1.06*d.* per passenger per mile, and 2.20*d.* per ton per mile for freight.

A SCHEME is under consideration in Mexico for tunneling the volcano of Popocatapetl through the wall of the crater, in order to reach the immense sulphur deposits inside the mountain. A narrow-gauge railway is to connect the tunnel with the town of Amecameca, which in turn, will connect with the Morelos road, leading to the national capital.

A less expensive and equally effective plan would seem to be by wire haulage over the top.

A ST. LOUIS company, of which Mr. WM. A. ADAMS is President, has been drilling for oil in the Choctaw Nation, I. T., and has just completed a well near Lehigh which is flowing 30 barrels a day. The oil was struck at a depth of 833 ft.

THE SPRINGFIELD FOUNDRY CO., of Springfield, Mass., gave a dinner to its employés recently and announced the results of the first year's profit sharing with its workmen. This company is the first in that part of New England to make a practical test of the plan of dividing a portion of its profits among the men, and the outcome of the experiment was looked for with very considerable interest. The dividend announced amounted to 2½ per cent. on the wages for the year for all who entered the service of the company before April 1, 1887. This dividend can either be collected in cash or it can be deposited with the company on 5 per cent. interest. In a circular issued to the employés the company state that while it can hardly be said that the profit sharing plan produced any marked results in dollars for the first year, they hardly expected this. But the men appreciated the new plan and have honestly and heartily tried to do well, and the company will continue the experiment for another year.

High Masonry Dams.

(*Concluded from page 771.*)

In the course of these studies Mr. ED. WEGMANN, Jr., Special Assistant Engineer, who was entrusted with the mathematical computations connected with the subject, devised a simple and exact analytical method for determining directly the profile of a masonry dam.

That method is based primarily on the fundamental formulæ for distribution of pressure already mentioned, and on the limiting conditions, viz.: that the resultant when the reservoir is full or empty, shall lie within the center third of the base of the profile; and that at no point of the faces shall the elementary pressures exceed certain fixed limits.

For the purpose of calculation, the section of the dam is supposed to be divided in horizontal slices of a given height, to which the method is applied in succession. The vertical component of the water pressure on the slopes of the up-stream face is neglected.

Reference to the units of weight, etc., employed in the calculations for the Quaker Bridge dam will be made hereafter.

The symbols employed are as follows:

W = Weight of masonry above the layer under consideration.

W_1 = W plus weight of layer under consideration.

m = Length of upper joint, already determined.

l = Length of lower joint, to be determined.

$2h$ = Depth of layer.

d = Distance of point of application of W from back end of joint m. (Reservoir empty.)

u = Distance of point of application of W from front end of joint l. (Reservoir full.)

u' = Distance of point of application of W from back end of joint l. (Reservoir empty.)

p = Elementary pressure at front end of joint l. (Reservoir full.)

p' = Elementary pressure at back end of joint l. (Reservoir empty.)

M = Moment of water pressure about the horizontal plane through joint l.

a = Vertical distance of flow line below top of profile.

ϑ = Ratio of unit weight of masonry to unit weight of water.

The method as applied to a general profile consists of two initial equations.

First initial equation (a).—The first initial equation (a) applies to that portion of the profile in which the back face is vertical and covers the case in which the limiting pressure obtains on the front face. It gives the length l of the joint.

$$\text{Equation } (a)\quad l^2 + \frac{2\,W\,l}{p} = \frac{6\,d\,W + 2\,h\,m^2 + 6\,M}{p}.$$

If the resultant (reservoir full) falls at the extremity of the middle third of the joint, equation (a) becomes equation (b).

$$\text{Equation } (b_1)\quad l^2 + l\left(\frac{2\,W}{h} + m\right) = \frac{3\,d\,W}{h} + m^2 + \frac{3\,M}{h}.$$

Equation (b) again transformed becomes equation (c_1), which gives the depth at which the front face ceases to be vertical (assuming a certain top width for the profile); i.e., the section being a rectangle of given base, it gives the depth at which the resultant (reservoir full) will intersect the extremity of the center third of the joint.

$$\text{Equation } (c_1)\quad h^2 - \frac{\vartheta\,h\,l^2}{4} = \frac{\vartheta\,a\,l^2}{8}.$$

Equation (c_1) assumes that the top of the profile is *above* the level of the flow-line; if, on the contrary, the top of the profile coincides with the flow-line, Equation (c_1) becomes Equation (c^2).

$$\text{Equation } (c^2)\quad h^2 = \frac{\vartheta\,l^2}{4}.$$

Second initial Equation (d).—The second initial equation (d) applies to that portion of the profile in which both faces have a batter, and covers the case in which the limiting pressure exists on both faces of the profile.

$$\text{Equation } (d)\quad l^2\,(p + p' - 2\,h) - 2\,l\,(W + h\,m) = 6\,M.$$

If the resultant, when the reservoir is empty, falls at the extremity of the middle third of the joint, then equation (d) becomes equation (e^1).

$$\text{Equation } (e_1)\quad l^2 = \frac{6\,M}{P}.$$

If both resultants (Reservoir full and empty) fall at the extremities of the middle third of the joint, then equation (e) becomes equation (f).

$$\text{Equation } (f)\quad l^2 + l\left(\frac{W}{h} + m\right) = \frac{3\,M}{h}.$$

It is obvious that since equations (d), (e) and (f) apply to that portion of the profile in which both faces have a batter, the length of the joint (l) derived from them does not fix the batters of the layer in hand. This renders necessary the supplementary equation (g) by which the offset (x) on the back face is determined.

$$\text{Equation } (g.)\quad x(3\,W + 2\,h\,m + h\,l) = W\,(2\,l - 3\,d) + h\,m\,(l - m) + l^2\,\left(h\,\frac{p'}{2}\right).$$

If the resultant (Reservoir empty) falls at the extremity of the middle third of the joint, equation (g) may be simplified to the form of equation (h).

$$\text{Equation } (h.)\quad x\,(3\,W + 2\,h\,m + h\,l) = W\,(l - 3\,d) - h\,m^2.$$

The above equations apply to a general profile. In the Quaker Bridge dam, for reasons which will be explained hereafter, very long, straight slopes have been adopted for the lower portion of the profile; and the calculations for a theoretical profile were complicated by the fact that some 87 ft. of the structure is below the river-bed, and consequently subjected to additional strains due to the weight of the overlying gravel, and by a counter-water pressure. This special case has been submitted to analysis and the following equations have been deduced.

The depth of gravel overlying the base is represented by $2\,g$.

Total depth of layer = $2\,h$.

$$\text{Ratio } \frac{g}{h} = \theta$$

Ratio of unit weight of gravel to unit weight of masonry = β

The limiting conditions being that certain pressures shall obtain on the upstream and downstream faces at bed rock, equation (k) gives the length of the base at bed rock.

Equation (k):

$$l^2\,[(p' + p) - 2\,h\,(1 + \theta^2\,\beta)] + 2\,l\,[h\,m\,(\theta^2\beta - 1) - W'] = 6\,M.$$

Equation (l) gives the offset (x) on the back face.

Equation (l):

$$x\,[h\,l\,(1 + 2\,\theta^3\,\beta - 3\,\theta^2\,\beta) + h\,m\,(2 - 2\,\theta^3\,\beta) + 3\,W'] = h\,l^2\,(1 - \theta^2\,\beta + \theta^3\,\beta) - h\,m^2\,(1 - \theta^3\beta) + h\,l\,m\,(1 - 2\,\theta^3\,\beta + \theta^2\,\beta) - 3\,W'\,d + 2\,W'\,l - \frac{p'\,l^2}{2}.$$

With the exception of formula (c_1), a simple equation of the third degree, it may be noticed that all the others are of the second degree only. In regard to the last two, which may appear too long for practicable purposes, it can be seen that they are of easy solution, and that they cover the special case when the lowest calculated section is partly built in gravel overlaying the bed rock, with a counter pressure of water.

The following table shows the application of the above formulæ to the theoretical profile for Quaker Bridge dam:

Elevations of Joint.	Limiting Conditions. Front face	Back face	Equations Employed.	Values Found. For l	For x
171.3	$u = \frac{l}{3}$	.....	(c_1)	$l = 20$ (2h = 34.7)	
156.	$u = \frac{l}{3}$	.....	(b)	26 2	
136.	$u = \frac{l}{3}$	.....	(b)	37.4	
116.	$u = \frac{l}{3}$	$u' = \frac{l}{3}$	(f) & (h)	53.4	2.3
96.	p=8.2 tons per sq. ft.	$u' = \frac{l}{3}$	(e) & (h)	71.2	2 0
—52.	p = 15 tons per sq. ft.	p = 15 tons per sq. ft.	(k) & (l)	231.8	25.4

It is by this method that the theoretical profile of Quaker Bridge Dam, shown (Fig. 4), has been computed; the results have been afterwards confirmed by means of graphic and other methods. The elements of the calculation are as follows:

The limit of pressure assumed at the down-stream face of the profile is, for a depth of water of 110 ft. (elevation + 96) and less, 8.2 tons of 2,000 lbs. per sq. ft.

At the back or up-stream face, the condition that the resultant should fall on the end of the center third of the base led to a pressure, at the end of the horizontal joint, at elevation + 96, of 8.7 tons per sq. ft.

From 110 ft. depth (elevation + 96, to the base of the dam (elevation — 52) the assumed pressures increase steadily until they attain the maximum value of 15 tons (30,000 lbs.) already mentioned.

For the sake of simplification, the vertical weight of the water on the inclined portion of the up-stream face is neglected, this slight error being on the side of safety. The vertical weight of the saturated gravel resting upon the slopes of the dam below the river bed is taken into account. The gravel on the down-stream side of the dam being saturated with water, the resulting counter-pressure of water enters into the computation. The weight of a cubic foot of water is taken at 62.5 lbs. The weight of a cubic foot of masonry, for reasons already given, is taken at 156.25 lbs. The weight of a cubic foot of saturated gravel is taken at 145,875 lbs., equivalent to 0.94 of the weight of masonry (the dry gravel being assumed at 125 lbs., with voids equal to one-third of the bulk filled with water). The unit of weight used throughout is the weight of one cubic foot of masonry. It has been already stated that this choice of unit simplifies the calculations greatly. The effect of wind pressure on the dam has been neglected. If it blows down the valley when the reservoir is empty, its tendency is to increase the stability; if it blows in the other direction the result is the same with a full reservoir, and with an empty or partially empty basin the margin of safety is more than sufficient to counteract the comparatively insignificant effect of the wind pressure.

The result of the calculation is shown on Fig. 4, which gives the theoretical profile of the dam, and on Table II., which explains itself:

The theoretical profile of the dam being determined, certain modifications were advisable to meet some practical requirements of adaptability and of construction. The width of the top had to be adapted to the requirements of a roadway. A slight addition to the thickness of masonry down to elevation 170 (*i. e.*, the part covered by the fluctuations of the water surface in the reservoir) presents the double advantage of increasing the strength of the structure at a point where it may have to sustain shocks from the action of the waves and ice, and of adding to the symmetry of the profile. It is also advisable for the purpose of facilitating construction to so regulate the various inclinations of the faces as to give them a simple ratio easy to follow during the building operations. Last, as no dependence can be placed on the strength of the sharp triangle of masonry forming the extreme toe of the down-stream face, it is advisable to dispense with it, and to round it off in the form of steps, as shown on the general section. This disposition presents the additional advantage of lessening the width of the expensive excavation to be made in the bed of the river.

These modifications having caused some changes in the distribution of the materials, obviously rendered necessary a new computation of the distribution of pressures throughout the mass of masonry. To this end the proposed profile was divided into horizontal sections or slices 11 ft. high. The centers of gravity were found by the usual system of moments for each joint; the overturning moments, etc., were ascertained, and the pressures computed as before in accordance with the formula (1), the various units and elements of calculation being the same as those used for the computation of the theoretical profile.

Table III. gives a synopsis of the results obtained, and shows that: The total width of the base is 216 ft. The maximum pressure at toe of up stream face is 15.4 tons per sq. ft. (13.8 tons of 2,240 lbs.). The maximum pressure at toe of down-stream face is 16.6 tons per sq. ft. (14.8 tons of 2,240 lbs.). Average pressure on base, per sq. ft., 10.49 tons.

In accordance with the views already discussed in this report, these results are acceptable, and the profile, shown on the general section is recommended for the acceptance of the Aqueduct Commissioners.

Before closing these remarks on the profile of high masonry dams it is proper that we should refer to several modern structures which, owing to their magnitude and to the known skill of the engineers who designed them, were duly considered by us, namely: the Gilleppe dam in Belgium and the Vyrnwy dam near Liverpool, England, (See Plates No. 1 and 2).*

The evidently excessive section of the Gilleppe dam was due, as its designer admits, to local reasons of expediency independent from technical considerations. The Vyrnwy dam is intended to be used as a weir, and its shape is such as to lead the water properly in its fall and to support a heavy apron on the down-stream side. The special conditions under which these dams were designed do not obtain in the case of Quaker Bridge dam, and there was no valid reason to follow their peculiar profile. A dam has been recently begun near San Mateo, for the Spring Valley Water Company of San Francisco (California), which will be almost as high as the Furens dam, its height being 170 ft, (See Plates Nos. 1 and 2).* It is to be 20 ft. wide at top with straight batters. It is to be built of concrete blocks formed in place with a mortar of Portland cement. The description of this structure, now at hand, does not mention whether the engineer has more confidence in concrete than in stone masonry, or whether his choice was determined by economical or other reasons foreign to the constructive value of these materials.†

After determining the profile of Quaker Bridge dam, the next question in importance is to decide on the plan of the dam, whether it should be straight or curved. Referring to the list of dams now in operation, it will be seen that both plans have been followed with successful results. If we consult the various authorities on the subject, we find the almost unanimous

* In ENGINEERING NEWS of Jan. 7, 1888.

†See N. Y. Daily *Tribune*, October 2, 1887.

opinion that if a curve be adopted for the plan of a dam, it is advisable, notwithstanding, to so proportion the profile of the section as to make it able to stand, by its own gravity, the pressure of the water; the curved form, in other words, is considered as a sort of additional co-efficient of safety. We fail, however, to see how a mass of masonry, proportioned to stand water pressure by its own gravity, can at the same time act as an arch; if the profile is sufficient, the mass will not yield under pressure, and if it does not yield, no pressure can be transmitted to the sides through the curve; the two conditions are incompatible.

If, on the contrary, the section of masonry is not sufficient to support the water pressure, then the mass will yield to a certain extent under the strain, and some pressure will be transmitted to the abutments of the curve, *in the upper portion of the structure*; we say, in the *upper portion* because it is evident that, if there is, through the adhesive power of the mortar, rigid connection between the dam and the foundation rock, the adjacent parts of the masonry cannot, at the same time, act as an arch. Among the curved dams recorded herein we find that all, with one exception, have sections sufficient to resist the water pressures brought to bear upon them, and that they do not act as arches. The exception is the Zola dam (in France); see Plates Nos. 1 and 2 and Table I.

The thickness of the masonry is so small that the resultant falls outside of the front toe and that (unless the excellence of its mortar, and, generally, of its masonry be exceptionally great), its stability is due to the fact that it is built in the form of an arch, the water pressure being transmitted to the abutments. Moreover, the form of its section shows that the intention of its designer was that it should act so.

As, however, the rigid connection of the dam with the rock of the foundation precludes, at that point, the idea of an elastic motion in the masonry and of a consequent lateral transmission of the strains to the abutments, it is impossible to state at what height above the foundation the dam begins to act as an arch.

Owing to the small width of the valley (a few feet at the bottom and about 200 ft. at the top) the strains thus produced are evidently such as can be sustained by the masonry, but it is probable that the failure of one part of this dam would cause its total ruin, while, with a self-supporting section, a dam may fail at one point, leaving the balance whole. Such was the case at the dam of Gran Cheurfas (Algeria).

If we leave this special instance to return to general cases, we must call attention to the important fact *that the admissibility of the arch form in the plan of a dam must depend primarily on the intensity of the lateral or horizontal strains that would be transmitted through the structure.* In the case of curved dams thrown across *narrow valleys*, it may be found that the lateral strains (admitting that any should be developed), would be such as the masonry could safely support, and, if it is expected that the upper part of the structure might be put under pressure when the mortar, not being wholly hardened, is in a comparatively yielding state, we conceive that a certain amount of motion of the masonry, however small, may be expected, causing the portion affected to act as an arch with the tendency of closing the joints under pressure.

This advantage can hardly be claimed, however, for structures which are not made of voussoirs, but composed of an irregular mass of stones and mortar, which cannot be relied on for arch work, unless the whole is sufficiently hardened to present an homogeneous and monolithic character. When, on the contrary, the width of the valley is such that the strains transmitted by an arch would become excessive, that form must be avoided. Let us look at the case in hand. Great care has been taken in designing the profile that no strains superior to 15 tons should be produced by the combined action of the water pressure, and of gravity; other strains will be developed by variations of temperature; additional local strains will occur, owing to unavoidable irregularity in the quality of the workmanship. Would it be prudent to complicate matters by knowingly submitting the masonry to additional horizontal strains which would be very high, attaining a maximum of over 40 tons per sq. ft.; as far as we can calculate such values, for "in the present state of science, the calculations of stability, treating the dam as a horizontal arch, are so uncertain as to be of doubtful utility." The best information we have in regard to the stability of stone arches comes from experimental data, and we have none bearing on arches of such a great span.

In accordance with these views it is concluded: That a dam of such a length as Quaker Bridge dam, if acting as an arch, would be subjected to excessive strains. That, with the profile recommended, it can successfully resist in all its parts, the pressures applied to it, without any additional support. That, if built on a curve, it would not act as an arch, and would be more expensive. That it is advisable that the dam should be built in a straight line.

Let us consider, now, other features of importance, second only to the profile and plan of the dam, *i. e.*, the height of the crest of the dam above the water line and the capacity of the weir over which the surplus water is to flow.

Existing dams furnish good data in regard to the height to be given to the structure, and in accordance with precedents and with the recommendations of reliable authorities, the top of the parapet has been placed at an elevation of 13 ft. above the ordinary water mark, equivalent to 7 ft. above the extreme high water mark, the surface of the roadway being 3 ft. below the top of the parapet. This height is amply sufficient to cope successfully with the highest waves which may be expected from the unusual depth and considerable extent of the reservoir. As to the capacity of the overflow, it is necessary to depart from precedents on account of the extent of the water-shed and the comparatively heavy rainfalls that occasionally occur in the Croto-Basin. Judging from the possibilities of rain or thaw in this and neighboring water-sheds, the flowing capacity of the overflow should not be less than equivalent to the flow, in 24 hours, of a volume of water represented by a uniform thickness of 6 ins. over the whole water shed.

It is true that no such flow is on record, and the actual flow may never, it is hoped, come to that figure; but a combination of adverse circumstances, such as an exceptionally heavy rainfall, occurring at a time when the reservoir is already full, and when the ground is covered with snow, can bring about such a condition of things, and it is wise to be prepared for it. It can be so much more readily done, that an increase in the length of the overflow can be obtained at a comparatively small cost.

The writer, having had occasion to design the overflow of several dams on an equivalent basis, may be allowed to state that, on the occurrence of a freshet which produced a flow somewhat less than one-half of the quantity just mentioned, he could not but feel, in accordance with the sentiment of the people living lower down in the valley, that the channels of discharge were none too large. The length of overflow corresponding to these conditions is about 1,300 ft.

It may be mentioned here, that the gate house proposed to be built in connection with the dam, is to contain, besides the gates leading to the two aqueducts, some ample channels for the emptying of the reservoirs. These discharging channels, although placed a distance above the river bottom, are so arranged as to allow of the drawing of the bottom water, when necessary to do so.

In regard to the kind of masonry to be used, the majority of existing structures appear to be built of rubble; they generally give satisfaction, and there is no reason to depart from that practice. Concrete cannot be depended upon as being impervious enough to prevent percolation of water under great pressures and cut stone masonry, in connection with the great bulk of the dam, is obviously excluded on account of its cost. In all probability, stone suitable for the work can be found in abundance in the neighborhood, gneiss or granite being predominant; but in any case, the stone used must be one that will not disintegrate, under the influence of time or of the weather. A proper selection of stone is of such moment, and the distance from the work to the quarry or quarries is so important an element of cost (considering especially the quantities to be transported) that the territory in the vicinity of the dam should be examined by excavations, and, if necessary, by boring, in order to determine, before letting the work, the localities from which the stone is likely to come. Such an expenditure would be judicious, and would remove, to a great extent, the uncertainty under which the contractors would labor in making their bids, and the necessity under which they would find themselves to provide in their bids a large margin to meet possible contingencies of excessive cost in transportation.

The whole masonry of the dam, from bed rock to the top, should be homogeneous with the exception of the parts which, from requirements of ornamentation and maintenance, may be made of finer masonry. Mr. KRANTZ says that "the joints should be irregular on the faces and in all the sections; the courses should be thoroughly interlocked, or better still, there should be no courses, and by means of good work this result must be obtained, so that the whole body of the wall shall be a real monolith." Mr. E. S. CHESBROUGH, in a report on the subject to the Department of Public Works, states that: "The superstructure should be composed throughout of uncoursed, broken range rubble masonry built of quarry stone of irregular sizes, laid with full beds and joints. The use of cut stone should be confined to such appropriate ornament as may be desired, none being used in the body of the work, not only on account of expense, but also to avoid the introduction of two different classes of masonry. While, as above stated, coursing should be avoided, it would be proper to keep the work roughly levelled up over its entire length, say every 5 ft. in height, so as to secure an even settlement as the structure goes up."

To these remarks, which appear to resume the practice generally followed, it may be added that, for the purpose of keeping the faces in good order, and to preserve them from the action of the weather, it is advisable to make the joint closer on the faces or even to use range rubble with a close joint near the surface only, thus lessening the future work of keeping the outer joints well pointed, without disturbing the uniform settlement of the whole mass. In some of the old Spanish dams the faces are even lined with cut stones which are not reported to have caused any trouble.

As it is of vital importance that all spaces between the stones be filled completely with mortar, they must be of such size as can be easily handled, enabling the masons to secure, beyond doubt, a good bedding, and each stone, with the exception of the smaller ones used for filling up and leveling up cavities, should be so selected or shaped as to present a good bed which will form a solid joint with the level surface prepared to receive it; all projections presenting too irregular outlines should also be hammered off. These conditions do not admit of large sizes for the stones used, but their limits of size cannot be absolutely determined in advance, and they may vary with the quality of the stone used.

Large stones, as generally prepared for rubble work, cannot be properly bedded, and better and more expeditious work will be secured by the use of smaller ones. With few exceptions, the largest stones should not exceed two tons and the largest proportion should be much smaller. The face on the water side should be made as water-tight as possible, either by a careful pointing of Portland cement or by the introduction of a special impervious facing. Especial care will be necessary in designing the masonry of the gate house, which must not present large masses of masonry different in character from that used in the body of the dam, without forgetting that most of its parts will support heavier pressures. The gate house, however, is at a point on the side of the valley where the risks of unequal settlement are very much diminished by the reduced height of the structure. The same precaution must be used on the other side, where an opening must be provided for the flow of the river during construction. No special mention of the cut stone masonry to be used for the cornice and parapet work, for the gate house, for the overflow, etc., is necessary here.

This report would not be complete without a few words in connection with the part of the work which will precede the building of the masonry. Existing dams furnish no precedents of the deep excavation necessary here to reach the bed rock, and we find but few references to the manner of preparing the latter to receive the masonry. How to make successfully that deep excavation and to take care of the river during the excavating operations, and during the first part of the construction, is the problem presented. One plan originally suggested consisted in building across the valley, in heavily timbered trenches, and, from the rock bottom to the river bed, two walls of considerable thickness, forming the up-stream and down-stream faces of the dam respectively; under the protection of those walls, the earth could be removed between them and the wall completed.

Against that plan several important objections are found: In view of the depth of the excavation, which is, at the lowest point of the valley, more than 80 ft. deep, and in view of the inclination of the outer faces of the dam, these walls should be very thick, and the trenches containing them correspondingly wide. The excavation of such wide trenches, and their protection by timber, would be very costly, and would especially take a very long time.

The pressures at the bottom of the trench would be such as to require very heavy timbers placed very close together, thus forming an obstacle to the proper inspection, and to the expeditious and satisfactory laying of the masonry between them. Moreover, the rock bottom, under those difficulties could not be properly examined and prepared. It is obvious, also, that the dam would then be erected in its lower part in three parallel and disconnected vertical slices, instead of progressing regularly upward as it should be to secure the gradual settlement of the mass.

Notwithstanding the great depth of the excavation and the evident difficulties accompanying such an operation, the most advisable manner to proceed is to open it without side protection, and to maintain it by means of long slopes on each side. The free access thus procured to every part of the work will allow of the use of powerful mechanical means for removing the earth, and the cost of the excess of excavation, due to the formation of slopes, will be more than compensated by the rapidity and simplicity of the operations, which will obviously lower the cost of the cubic yard excavated, and shorten very much the time necessary to complete the work.

Another advantage of as great value will result from the unobstructed condition of the bottom of the trench which will permit a perfect inspection and preparation of the bed rock and a thorough treatment of the seams and fissures which will, most probably, be found. The foot of the slopes, if necessary, can be locally removed, for a considerable distance, to uncover and fill up im-

TABLE III.

SYNOPSIS OF DATA—ADOPTED SECTION—QUAKER BRIDGE DAM.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Elevation of Joint.	Depth of Water at Joint	Area of Masonry above Joint.	Distance from up-stream end of joint to point at which a vertical through centre of gravity intersects Joint. (w')	Distance from down-stream end of joint to point at which the resultant of weight and water pressure intersects Joint. (u)	Distance between points designated in Columns 4 and 5 (c)	Total length of joint equals sum of Columns 4, 5 and 6. (l)	Weight of Masonry above Joint. (W)	Horizontal Thrust of Water above Joint.	Distance of Center of Pressure above Joint.	Maximum Pressures. Up-stream end of Joint Reservoir Empty. (p')			Down-stream end Joint Reservoir Full. (p)			Ave'age pressure on Joint.	Fact'r of sat'ty ag'n't overturning.	Ratio of thrust of water to weight of masonry equals Col. 9 divided by Col. 8.	(1) El'vation of Joint.
Ft.	Ft.	Sq. Ft.	Ft.	Ft.	Ft.	Ft.	Lbs.	Lbs.	Ft.	Tons per Sq. Ft. 2,000 lbs.	Lbs. per Sq. Ft.	Lbs. per Sq. In.	Tons per Sq. Ft. 2,000 lbs.	Lbs. per Sq. Ft.	Lbs. per Sq. In.	Tons per Sq. Ft.			Ft.
173	33	773.1	10.40	9.00	3.10	22.50	120,797	34,031	11.00	3.29	6,578	45.7	4.29	8,588	59.6	2.68	3.90	.282	173
162	44	1,040.3	10.85	10.27	5.46	26.58	162,547	60,500	14.67	4.77	9,542	66.3	5.14	10.277	71.3	3.05	2.88	.372	162
151	55	1,358.0	11.70	11.30	8.17	31.17	212,188	94,531	18.33	5.99	11,973	83.2	6.21	12,425	86.3	3.41	2.38	.445	151
140	66	1,726.1	12.77	11.88	11.10	35.75	269,703	136,125	22.00	7.00	14,000	97.2	7.57	15,134	105.1	3.77	2.07	.505	140
129	77	2,167.1	15.09	15.33	14.04	44.46	336,609	185,281	25.67	7.48	14,960	103.9	7.36	14,716	102.2	3.80	2.09	.547	129
118	88	2,704.1	17.78	18.59	16.80	53.17	422,516	242,000	29.33	8.00	15,891	110.4	7.55	15,109	104.9	3.97	2.10	.573	118
107	99	3,336.9	20.70	21.80	19.38	61.88	521,391	306,281	33.00	8.40	16,797	116.7	7.95	15,891	110.4	4.21	2.12	.587	107
96	110	4,065.4	23.76	25.00	21.82	70.58	635,219	378,125	36.67	8.91	17,819	123.7	8.44	16,875	117.2	4.50	2.15	.595	96
85	121	4,907.4	27.93	30.51	24.06	82.50	766,781	457,531	40.33	9.15	18,291	127.0	8.27	16,544	114.9	4.65	2.27	.597	85
74	132	5,880.5	32.31	36.04	26.07	94.42	918,828	544,500	44.00	9.47	18,938	131.5	8.32	16,641	115.6	4.87	2.38	.592	74
63	143	6,984.7	36.83	41.59	27.91	106.33	1,091,359	639,031	47.67	9.84	19,688	136.7	8.48	16,966	117.8	5.13	2.49	.585	63
52	154	8,219.9	41.43	47.20	29.62	118.25	1,284,350	741,125	51.33	10.31	20,625	143.2	8.69	17,375	120.7	5.43	2.60	.577	52
41	165	9,586.3	46.08	52.85	31.24	130.17	1,497,859	850,781	55.00	10.79	21,578	149.9	9.00	17,997	125.0	5.76	2.69	.568	41
30	5 176	11,083.7	50.84	58.49	32.75	142.08	1,731,828 1,733,844	967,219	58.71	11.31	22,624	157.1	9.34	18,672	129.7	6.10	2.79	.558	30
19	16 187	12,712.1	56.18	63.90	33.92	154.00	1,986,266 2,006,688	1,084,781	62.75	11.80	23,609	164.0	9.83	19,672	136.6	6.52	2.88	.541	19
8	27 198	14,471.7	62.00	69.15	34.77	165.92	2,261,203 2,319,281	1,202,344	67.08	12.29	24,570	170.6	10.48	20,964	145.6	6.98	2.99	.518	8
−3	38 209	16,362.3	68.14	74.31	35.38	177.83	2,556,679 2,671,609	1,319,906	71.61	12.78	25,503	177.5	11.20	22,406	155.6	7.51	3.10	.494	−3
−14	49 220	18,384.0	74.48	79.47	35.80	189.75	2,872,500 3,063,672	1,437,469	76.31	13.29	26,578	184.6	12.00	23,995	166.6	8.07	3.22	.469	−14
−25	60 231	20,534.9	80.38	83.20	36.25	199.83	3,208,578 3,479,250	1,555,031	81.12	13.80	27,609	191.7	13.08	26,156	181.6	8.70	3.29	.447	−25
−37	72 243	23,003.9	86.12	85.85	36.86	208.83	3,594,359 3,949,796	1,683,281	86.48	14.43	28,859	200.4	14.51	29,016	201.5	9.45	3.33	.426	−37
−52	87 258	26,218.8	91.12	86.92	37.96	216.00	4,096,688 4,581,609	1,843,594	93.31	15.41	30,828	214.1	16.63	33,266	231.0	10.49	3.29	.406	−52

NOTE.—Small figures, Column 2, show depth of water on down-stream side of Dam; Also in Column 8, weight of masonry exclusive of gravel. Large figures, Column 8, show weight of masonry inclusive of gravel.
Total cubic contents of Dam proper, 496,862 cu. yds. Total weight of Dam proper, 1,047,882 tons.

portant seams, which it would be found advisable to follow outside of the actual base of the dam. The numerous borings made in the valley show that the materials would be, on the whole, favorable for such an excavation, provided the trench is well drained.

In order to thoroughly drain the trench, it would be well (in addition to the means provided to take care of the river water) to sink in the bed of the river, a short distance from the upper edge of the excavation, several wells provided with pumping appliances, for the purpose of keeping the slopes dry. It is well understood that the unusual depth of the proposed trench, and the constant presence above it of a body of water which, at times, may be very large, constitute difficulties of no mean magnitude, and that great care and foresight will be necessary to achieve success; but this mode of treating the question appears to be the most rational under the circumstances.

Closely connected with this subject is that of the conveyance of the river water over the work while the excavating and building operations take place below the level of the river bed. It is proposed to build two temporary wooden dams of little height, one above and one below the location of the dam, and to connect them by a water-tight timber flume, the distance of these dams from the edge of the trench to be determined later from a close examination of the grounds, to be not less in each case than, say, 200 ft. The dams should be of such height as to correspond to the highest water mark of the flume. What should be the flowing capacity of the flume? The records show an instance where the maximum flow of Croton river was about 8,000 million galls. in 24 hours. The construction and maintenance of a wooden flume (not less than 200 ft. wide), as formerly proposed, capable of safely containing such a stream, would be very expensive. It would require (supposing it to be practicable) great vigilance to keep it water-tight, owing to the constantly increasing depth of the excavations and to the consequent frequent change of supports. It would be, at best, a constant obstruction to the rest of the work, and should not be attempted.

In building operations of this character it is unavoidable that the builder should take some risks; but they must be reduced to a minimum within the limits of a reasonable outlay, and the writer thinks that the following manner of controlling the water, which is much less expensive, would afford more chance of protection from the water, although, in some contingencies, it may involve the temporary flooding of the work. Instead of maintaining the protecting flume over the work it is proposed to place it at one side, wholly or partially on a shelf of rock prepared, where necessary, for the purpose. The borings show that the north side would admit of such a treatment.

As to its flowing capacity, it would be sufficient to make it equal to the volume of the average spring freshet of the Croton river, corresponding to a width of about 60 ft.; but the flume must be so designed that if the river rises beyond its capacity, ample channels, prepared for that purpose on the rocky hillside, must be opened to safely fill up the trench, and allow the freshet to pass over the work without causing more than repairable damage. Time and money would then be required to restore the excavation to working order, but this risk is preferable to the constant maintenance of the larger channel during several years. As the work of masonry comes up above the level of the river bed, an arched opening can be left for the passage of the flume, to be filled afterwards when the dam is nearly completed.

After the earth is removed from the proposed foundation on the bottom and sides, all loose or doubtful ledge must be removed until sound rock is found, or until such depth is reached as will be judged sufficient for securing a water-tight connection between the dam and the rock. For the purpose of insuring imperviousness, and of increasing the resistance of the structure to sliding, the surface of the rock must present numerous projections which need not be regular. In case the rock comes out with smooth surfaces, it would be well to excavate one or more wide longitudinal trenches. It is obvious that any seams that may be encountered must be carefully followed and obliterated by such means as may be suggested by local conditions. If seams and fissures extend to such distance as may require a more thorough treatment, it may be necessary, at places, if not on the whole extent of the work, to penetrate the rock deeply on the bottom and sides with a central trench to be filled afterwards with masonry.

It need not be said that the cements to be used in the construction must be well selected. It would be well, in order to secure perfect work at the connection of the structure with the rock, to use imported Portland cement at all places wherever such connection is to take place, and in their vicinity, the mortar being in the proportion of one of cement to two of sand. The same mortar would also be preferable for the work to be done in the last season on the upper part of the dam and elsewhere, on account of the well known property of the Portland cement to acquire hardness in shorter time than the domestic brands, thus securing greater power of resistance for the masonry, if it happens to be subjected to full pressures immediately after the dam is put into service.

Portland cement mortar should also be used for the pointing of the outer joints. For the bulk of the dam, a mortar made of the same proportions of good domestic cement or a mortar of Portland cement in the proportion of three to one would be sufficient.

All the statements advanced, the conclusions reached, and the recommendations made in this report are presented on the supposition that every part of the work is to be executed with care, under intelligent and able superintendence; on that condition will depend the success of the undertaking.

The extensive borings made preparatory to the designing of the plan, especially the two diagonal borings made parallel with the sides of the valley under its whole width, seem to indicate the presence of good compact rock; the surface indications are also favorable, and although some difficulties are anticipated in preparing the foundations, it is confidently expected that they can be overcome.

Under the pressures to which the dam will be subjected, some leakage may be expected; such has been the case for several of the high masonry dams now in existence. If the leakage takes place through the masonry, experience shows that it diminishes gradually, and in regard to the grounds adjoining the dam, if the earth which covers them is not sufficient to prevent water from percolating through fissures that may exist in the rock, it is reasonable to expect that those percolations can be located and stopped.

In order to do full justice to this important subject, and to the investigation made of it, it would have been necessary to enter into more details in regard to the numerous questions which have been examined; but a complete record of them would have entailed many technical references hardly compatible with the scope and intent of this report.

Before concluding, the author desires to record his indebtedness to Mr. EDWARD WEGMANN, Jr., Division Engineer, whose work in connection with the mathematical parts of this research is already mentioned, and to Mr. IRA A. SHALER, Assistant Engineer, for their valuable assistance.

SOCIETY PROCEEDINGS.

Minneapolis (Minn.) Society of Civil Engineers.—The following officers have been elected for the year:

President, W. A. PIKE; Vice-President, E. B. ABBOTT; Secretary, WALTER S. PARDEE; Assistant Secretary and Treasurer, B. O. HUNTRESS; Librarian, W. W. REDFIELD; Member of the Board of Managers of the Association of Engineering Societies, ANDREW RINKER; Standing Committee on Membership, ANDREW RINKER, M. D. RHAME and R. A. SANFORD; Committee on Entertainment, GEORGE W. STURTEVANT, F. W. CHAPPELON; House Committee, W. W. REDFIELD, S. C. DEVERLY.

Illinois Society of Engineers and Surveyors. The Third Annual Meeting of the society was held at Springfield, Ill., Jan. 25, 26, 27. On the first day President I. O. BAKER gave his address in which he dwelt upon the importance of improving the highways, the necessity of reforming the present method of buying highway bridges, the desirability of closer inspection of the construction of water-works on the part of the city, the reasons why the railroads should make greater provisions for the safety of passengers and employés, and urged that at least one member of the State Board of Railroad Commissioners should be an engineer. Committee reports were received and a paper on "Perpetuation of Monuments and Laying out Towns and Cities" was read by T. C. MCCLANAHAN, County Surveyor, Monmouth.—On the second day the following papers were read: "Surveying Practical and Artistic," D. L. BRAUCHER, Lincoln; "Improved Bridges," J. H. BURNHAM, Bloomington; "Bridges and Viaducts for Cities", D. W. MEAD, City Engineer, Rockford; "Specifications for Bridge Iron," Prof. I. O. BAKER, Champaign; "Importance of Replacing Wooden Trestles with Iron and Stone Structures," J. M. HEALY, Div. Eng. I. C. R. R., Champaign; "Progress of the Cairo Bridge over the Ohio River," S. T. BALCOM, Asst. Eng. I. C. R. R. Champaign; "Artesian Wells," D. W. MEAD, Rockford; "A Railroad Culvert," E. A. HILL, Chf. Eng., I. D. & S. R. R. Indianapolis, Ind.; "Mine Surveying", F. V. ALKIRE, Petersburg.—On the third day the following papers were read: "Coal Fields of Colorado and New Mexico", A. C. BRAUCHER, Cañon City, Col.; "Hygienic Engineering and Architecture," G. N. KEIDER, Springfield; "The Township Boundary," Z. A. ENOS, Springfield; "How to secure Better Highway Bridges," J. O. WRIGHT, Lafayette, Ind.; "Range of Magnetic Declination," Prof. I. O. BAKER. Business was transacted, officers elected, and reports received.

Prof. BAKER was reëlected President, but declined, having held the position for 3 years. The following are the officers for the ensuing year: President, C. G. ELLIOT, Gilman; Vice President, D. W. MEAD, Rockford; Executive Secretary, S. A. BULLARD, Springfield; Executive Board, A. H. BELL, G. P. ELA, E. A. HILL. The next meeting will be held at Bloomington.

Railroads in Brazil.

A recent consular report gives the following particulars respecting railroads in the sugar producing provinces of Brazil:

"Province of Bahia: The facility for reaching every part of the interior is all that can be desired, owing to 800 miles of railroads, of which upwards of 587 miles are in actual traffic and the balance are in construction. These roads are as follows: Bahia & San Francisco (gauge 5 ft. 3 in). The main line with the above gauge has 76½ miles in traffic. The *ramal* of Timbo and the prolongation of the main line, with a 3 ft. 3½ in. gauge, will have 282.5 miles, and to reach the river San Francisco, the terminus of the road, 82 miles more will be constructed. Bahia Central (gauge 3 ft. 6 ins.), with 187½ miles, of which 179 are in actual traffic. Nazareth Railway (gauge 3 ft. 3½ ins.) has 22 miles in traffic. St. Amaro River Railway (gauge 3 ft. 3½ ins.) has 22 miles in traffic. Bahia & Minas (gauge 3 ft. 3½ ins.), to the limit of the province of Bahia; has 88½ miles in traffic. The railways of the country employ exclusively American locomotives, and the cars imported serve as models for those manufactured in the country.

Province of Sergipe: There is a concession given by the central government, with a subsidy of 6 per cent., for the construction of a railroad from Aracaju, the capital, to the rich district of Simao Dias, 113 miles.—Province of Pernambuco: Recife & San Francisco R.R. (5 ft. 3 ins.), with 77 miles of main line and 90 miles extension to Garanhuns, with a 3 ft. 3½ in. gauge, all of which is soon to be opened for traffic. Recife & Caruaru (3 ft. 3½ ins.), total length 85 miles. Recife & Limoeiro Railway (Great Western Ry.), with 88 miles.—Province of Alagoas: Paulo Affonso Railway (3 ft. 3½ ins.), with 72½ miles, from the port of Piranhao (south of Macelo) to Jalota, in the province of Pernambuco. Central Alagoas Railway (3 ft. 3½ ins.), from the port of Jatagua, near Macelo, to the Villa da Imperatriz, 54½ miles westward of the province.—Province of Parahyba: there is a railroad from Cabedello, at the entrance of the Parahyba river, to Mulungu, in the interior of the province, with 41¼ miles, and from that village two branches east and west, with 28½ miles.—Province of Rio Grande do Norte: Natal & Nova Cruz Railway (3ft. 3½ ins.), running from the capital, with 75¼ miles in traffic, and 26½ under construction, starting from Ceara Merim, a rich sugar district.—Province of Ceara: Sobral R.R. (3 ft. 3½ ins.), from Camocino, a seaport, to Sobral, 80 miles in operation, and an extension from Sobral to Ipu, 34½ miles under construction. Baturité Railroad (3 ft. 3½ ins.), this line with its three branches, will have 65 miles, and with a contemplated prolongation to the most fertile part of the province, Ceara will be free from these periodical droughts which devastate the land and afflict its inhabitants, as water can be easily carried from the numerous rivers of that locality.

Sewage Precipitation by Electricity.

The London *Standard*, without describing the detail of the process, claims that actual experiment has demonstrated the fact that a current of electricity can be so applied to a volume of sewage as to effectually purify it in 20 minutes. According to this account a separation of the solids and liquids is effected, with an entirely harmless effluent. The organic matter rises to the surface there to collect in a scum, with an upward tendency which is supposed to be produced by liberated gases. No chemicals are introduced into the sewage. It is the invention of Mr. WM. WEBSTER, Jr., F. C. S., and he proposes to apply the same apparatus to the purification of water.

In commenting on this new scheme the London *Engineer* very properly states that it awaits further light and data of detail, cost of plant and maintenance. With our English contemporary we are not prepared to doubt the possibilities of the electric current, even when applied to sewage purification, especially as we have, within the month, noted an apparently similar application of the electric current to the purification of water by two Pittsburg inventors, and for which process a patent is now pending in this country.

THE January traffic report for the Brooklyn Bridge shows total receipts $74,028. The total expenses, less $7,000 paid for real estate, were $68,562. The promenade reported 125,538 patrons, and the railway 2,521,786, making a total of 2,647,324.

Statue to Quauhtemoc, City of Mexico.

We depart a little from our usual strictly utilitarian programme, to give on our inset sheet herewith a view of what we feel to be by long odds the noblest, most poetically conceived and most skillfully designed piece of commemorative monumental work, on this continent, as well as one of the most curious and interesting. For some reason, it has not attracted the attention in print which it deserves, and we believe we are the first to worthily illustrate it. We especially call attention to the perfect symmetry of the proportions of the monument, and to its harmony with its surroundings. It stands on the fashionable afternoon drive of the *Paseo de la Reforma*, more fully described below, which, for more than a mile of its length is thronged every afternoon with carriages and horsemen, as well as foot passengers, in what is known as the *paseo*, a pleasing custom for which we have no equivalent, which takes every person of leisure in Mexico out to the common concourse for an hour or two in the afternoon, to see and be seen. The avenue is a broad one, and is enlarged at frequent intervals by "glorietas," or circles, several of which are already ornamented by fine monuments, including especially one to Columbus, but none, in our view, so fine as this. The palace of Chapultepec is seen in the distance at the head of the avenue, and beyond that again the high mountains (12,000 to 14,000 ft. high), which surround on all sides the great valley of Mexico. The grand snow-clad peaks of Popocatapetl and Ixtaccihuatl 17,300 ft. high, are to the left of the avenue hidden by the trees.

Stone benches like those shown at the right, surround the "glorietas" and are placed at regular intervals between them. As a hint for a stately avenue the *Paseo de la Reforma* is well worthy of remembrance by municipal engineers and others who have to do with the laying out of cities and towns.

The monument was erected to the memory of QUAUHTEMOC, the last Aztec emperor, who defended his country with heroic valor against the Spanish invaders, and yielded only when his army had been far more than decimated by hunger, sickness and combat, so that he could no longer resist. His last fight was almost within a stone's throw of the site of the monument.

On the relief tablets at the base are given two scenes from the brief official life of the emperor, who succeeded MONTEZUMA just before the final fall of the country. From the designer's description we translate as follows:

Designed to honor the memory of some of the primitive inhabitants of the country, the most appropriate architectural type was a renaissance of those details of design which one may find today in the ruins of Tula, Uxmal, Mitla and Palenque, preserving as far as possible the architecture of those ancient peoples, which contains a richness of detail which might well grow into a true National style. There has been intentionally used not only features of Aztec architecture proper, but also those found in other ruins in Mexico, in order to honor still more the culture of the primitive inhabitants, so notable considering its epoch and conditions.

To fulfill the purposes which the Government had in starting the matter the author took into account that the ancients honored their gods by placing them in *teocallis* or temples which always approximated to a square base with inclined sides, with an outer stairway leading to the upper part. In analogy with this, the body of the monument rests upon a base which approximates to the general form of the *teocallis*.

The principal body of the monument was designed to display in all its parts and details the richest features of the ancient architecture, crowning it with a pedestal on which stands the figure of QUAUHTEMOC.

Every effort was made to preserve the purity of style, and for this reason also, the whole was designed of basaltic rock, ornamenting it with Grecian fret-work copied from the ruins of Mitla. The base is octagonal, with the object of softening the transition from the square base to the circular "glorieta" or pavilion enlargement within the Paseo de la Reforma. The four flights of steps by which this base is approached are guarded by eight leopards, that being the only wild animal native to the country.

The main base of the monument approximates to to the general form of one of the palaces of Mitla, and its fret-work is copied from the same palace. On its front and back it has two inscriptions, and on its sides two great bas reliefs, that on the left, the scene when the captive monarch begged CORTEZ to kill him with his dagger, because "he was no longer able to defend his country"; that on the right representing the torment by fire to which he was subjected by order of CORTEZ, instigated by the avarice of his treasurer ALDERETE and others (as well as by his own), in order to compel revelation of where the Aztec treasure was hidden. The moment chosen is when his companion in suffering, the King of Tacuba, conquered by the torture which was burning the soles of his feet, complained to QUAUHTEMOC (the name is spelt indifferently with *C* or *Q*) of his sufferings, and begged him to reveal where the treasure was, and QUAUHTEMOC answered stoically, "I seem rather to be lying on a bed of roses," and suffered his torture to the end without sign of weakness.

Above the base comes a simple "zocalo," or square member, having on each of its faces the names of four of the principal allies and generals of QUAUHTEMOC, most distinguished in the defense, viz., CACAMA, COANACOCH, CUITLAHUAC, and TETLEPANQUETZAL. Above this again are four corner groups of three columns each, copied from those which exist in the Toltec city of Tula, in all their details and hieroglyphics.

At the side of the columns are stone wings decorated with fret-work copied from Toltec edifices, and between these, on all four faces, are bronze tablets, ornamented with trophies made up of Aztec arms and habiliments of war.

The cornice above has immediately over the columns the general form of those of Palenque, the ornamentation being copied from the ruins of Uxmal, and the decoration of the frieze showing more Aztec arms and trophies. For the pedestal which supports the statue of the heroic monarch, various other general forms are used which can be studied in the antiquities which exist in the collection of the National Museum at Mexico, the facets being decorated with the symbol by which the Aztecs were accustomed to designate QUAUHTEMOC, which consisted of the wing of an eagle over the print of a human foot, the latter in Aztec hieroglyphics signifying the earth, the whole saying in symbolic language that QUAUHTEMOC was an eagle which had fallen to to the earth.

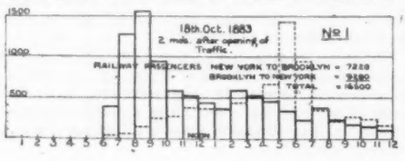
The capitals of the pedestal are decorated with knots formed of rattlesnakes, much used by the Toltecs for ornamentation.

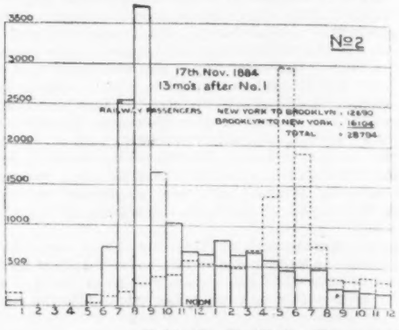
The statue represents QUAUHTEMOC prepared for combat, bearing in his right hand an arm which the Aztecs called *itacochtle* and with his left grasping the proposals of peace which CORTEZ had sent, whom he is about to defy. On his head is the feathered symbol called *cojulli*, which was the sign of royal authority, as also the mantle, or *filmatli*, which is further ornamented with royal insignia.

The whole monument is constructed of dark stone, black and gray, in order to preserve the character of the Indian remains, which are nearly always of basalt. The statue, bas-reliefs and similar decorative features are of bronze. These and all other parts of the work, were manufactured in Mexico. So far the description. As a whole, the monument must be admitted to be a work of art indeed, simple, poetic in its conception and execution, harmonious in its details, restful and satisfying to the eye. It seems to us to make poor indeed most of our own efforts at monumental commemoration, and its inherent merit is made still greater by the felicitous choice of a site, which is on the grand avenue referred to, which runs in an air line for some two or three miles from the fashionable end of Mexico out to the palace of Chapultepec. The latter stands on a small eminence of some 200 ft said to be in part of artificial origin, and has from the dawn of history been the home of the rulers of Mexico. The view from the palace is one of enchanting beauty, and it is surrounded by a noble park, especially notable for its enormous cypress trees, which would be large even in California and were old even in the time of Montezuma. They are said to have been formerly plentiful about Mexico, but now exist only in the Chapultepec park, except a single specimen, known as the "tree of the *noche triste*" (sorrowful night), under which CORTEZ gathered his scattered fugitives on the night of his great defeat, and which has since been religiously preserved as a memento of that narrow escape from the destruction which the Spaniards so richly merited.

The inauguration of the monument was attended by vast crowds of the descendents of the old Aztecs from all over Mexico, and revealed an unexpected depth of feeling on the subject among the common people, who had been supposed by this time to have well nigh forgotten all the traditions of their history. The feeling shown by these simple people was very deep and QUAUHTEMOC himself, could he have looked forward three centuries and a half to such a celebration, might have been gratified.

As there is much misunderstanding as to the real nature of these modern Aztecs, and as to the people of Mexico as a whole; and as Mexico bids fair to be of increasing importance in an engineering way, it has occurred to us that a few words as to "The People and Prospects of Mexico" might be of interest, and we have said them on the editorial page.


18th Oct. 1883
2 mos. after opening of Traffic.
No 1
RAILWAY PASSENGERS NEW YORK TO BROOKLYN = 7210
BROOKLYN TO NEW YORK = 7290
TOTAL = 14500
NOON


No 2
17th Nov. 1884.
13 mos. after No. 1
RAILWAY PASSENGERS NEW YORK TO BROOKLYN = 12690
BROOKLYN TO NEW YORK = 16104
TOTAL = 28794
NOON

Cable Car Traffic by Hours, and
Dotted lines, traffic from
Solid lines, traffic from

Growth of Traffic over the Brooklyn Bridge

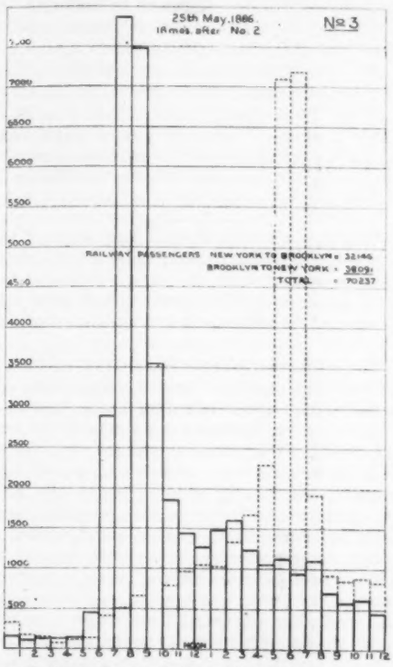
The four contrasted diagrams above, all drawn the same scale, tell their own story of marvellous growth, without much comment. We have prepared them by selection from a series of eight or ten compiled by the engineer department of the bridge, excluding intermediate dates at irregular intervals, so as to have the diagrams separated by as nearly as may be equal intervals of time. We have also somewhat modified the method of constructing the diagrams with, it is thought, some improvement in clearness.

The first diagram shows the small beginnings of the traffic, which was at the time considered large and satisfactory, two months after the opening of the bridge, or a little over 4 years ago. The second diagram shows what the traffic had grown to 13 months later, under substantially constant conditions. Up to this date the traffic was handled in two car trains, at 5 cent fares.

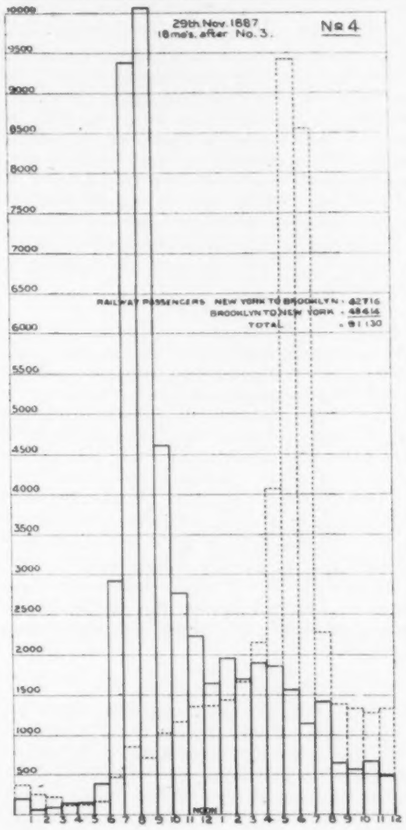
The third diagram shows what the traffic had grown to 18 months later, under the combined stimulus of 3 car trains, 3 cent fares and a single elevated railway. An interesting feature is that, whereas there had been only one morning and one evening crush hour there was now (as there still is two of nearly equal traffic, viz. 7 to 9 a. m. and 5 to 7 p. m. It is altogether probable, however, that a single hour might be taken out of the middle of each of these periods when the traffic is at a much higher rate than the average of the whole two hours.

The fourth diagram shows what the traffic had grown to 18 months later yet, or only a few weeks

ago, still under the same conditions. In other words, no new stimulating cause whatever intervened between Diagrams 3 and 4 any more than between Diagrams 1 and 2, other than natural growth, although between 2 and 3 there were very important modifying causes introduced to stimulate growth. The trains are still 3 car, the fare 3 cents, and there is only one elevated feeder line, although three


25th May, 1886.
18 mos. after No. 2
No 3
RAILWAY PASSENGERS NEW YORK TO BROOKLYN = 32146
BROOKLYN TO NEW YORK = 38091
TOTAL = 70237
NOON

Growth thereof, over the Brooklyn Bridge.
New York to Brooklyn.
Brooklyn to New York.


29th Nov. 1887
18 mo's. after No. 3.
No 4
RAILWAY PASSENGERS NEW YORK TO BROOKLYN = 42716
BROOKLYN TO NEW YORK = 48414
TOTAL = 91130
NOON

others will shortly be in operation. Under these conditions the growth is great indeed, and certainly goes far to justify the conclusion, which we believe to be the correct one, that until the traffic has grown to be many times greater than now—fully six or eight times—its volume is simply a question of the character and abundance of facilities. At present people are being driven away from the bridge by the thousands by the fearful crush at the termini, so that the volume of traffic is no evidence of what it would be, even without further growth of the cities, with these and many other difficulties and disadvantages removed. We trust to be able soon to present fully the plans which have been formed to meet the evident requirements for enlarged capacity, through the appearance of a report from the Board of Experts, (consisting of Messrs. WALTER KATTE, JULIUS W. ADAMS and JOSEPH CRAWFORD) which has had all plans for this end under consideration for something over two months and will now, we presume, soon report its conclusions.

One fact however is notable: The bridge facilities have been from the first more or less behind the requirements. The various steps for enlarging capacity have only come after the necessity had been for some time evident. The effect of one simple difference only,—keeping the facilities a little *ahead* of the requirements at all times, instead of a little *behind* them, is one yet to be tried, but that the traffic would be to-day vastly greater than it is now had this slight difference only existed from the first we take to be beyond question by intelligent people. As all it costs to do this is a little foresight (since the extra money cost is more than repaid by a very trifling growth of traffic) one would have expected that an enlightened regard for their own interest would have caused the Brooklyn people to insist on this from the first,—but they have not insisted, nor do they give as yet much evidence of intending to do so. The ferry traffic being in the neighborhood of 45,000,000 per year, against 30,000,000 over the bridge, there is chance for a very heavy addition to the bridge traffic merely by subtraction from the ferry traffic if facilities for handling it existed. At present, it is within our knowledge that Brooklyn residents having offices within three blocks of the bridge entrance take the ferries in preference, with a considerably longer walk, in order to avoid the discomforts of the bridge transit.

No statistics exist for a comparison of the New York elevated traffic with the bridge traffic by single hours, but the New York elevated day has been divided up into periods of two to four hours long on the elevated, and by adding together the bridge traffic for the same periods we have prepared comparative diagrams which we shall give next week, with some statistics referring only to the New York lines, and which have some very interesting features.

PUBLICATIONS RECEIVED.

A Text Book on Roofs and Bridges. Part 1: Stresses in Simple Trusses. By MANSFIELD MERRIMAN, Professor of Civil Engineering in Lehigh University. New York, John Wiley & Sons, 1888. pp. 118; 80 figures and diagrams; 6¼x9½ ins. $2.50.

Although the number of printed pages in the above book is 118, it is twice the thickness which would be found in an ordinary book of that size as each alternate leaf is left blank for the student to solve his problems upon, thus retaining the results of his work in a permanent form. The three chapters of the book are devoted to Roof Trusses, Highway bridges, and Railroad bridges. The general principles by which stresses are determined are stated at the outset and illustrated by application to the simplest forms of roof trusses. While there is anything but a dearth of books treating of bridge stresses in the language, it is quite true that in many volumes the student's path to a practical knowledge of computing stresses in any form of simple truss is made far too difficult. Any new book on the subject should receive a careful examination from teachers in technical schools; and one written by an instructor of Prof. MERRIMAN'S experience and standing can hardly fail to meet especially well many of the requirements of class room use.

The Engineers' Catechism. A Practical Treatise for the Use of Those in Charge of Steam Plants, by GEO. L. FOWLER, American Railway Publishing Company, 113 Liberty St., New York, 1888. 183 pp. 23 illustrations, 3½ × 5½ ins. cloth bound, $.50.

Perhaps there are still people who will be surprised to know that the catechetical method of imparting knowledge is no longer monopolized for teaching religious truths. In certain departments of technical literature, notably steam engineering, its straightforward way of settling one thing at a time has recommended it for quite extensive use. The above book is intended to instruct firemen and stationary engineers in all matters pertaining to the caring for and proper operation of steam engines and boilers, and is also well worth careful reading by manufacturers who wish to understand the proper operation of their power plant. It is an excellent feature of the book that it confines itself strictly to its proper scope and makes no attempt to introduce abstruse scientific or mathematical matter beyond the comprehension of the mass of those to whom it is addressed.

The Trans-Caucasian Railway.

Prof. LORENZ, of Brunn, Austria, gives a lengthy illustrated account of the Pati-Batoum—Tiflis—Baku railway in the last number of the official organ of the Austrian Engineers.

This railway connects the Black and Caspian Seas, and commencing at the Black Sea end, runs up the Rion river to Rion; crosses the mountains at the Suram Pass, and reaches the Kur river at Mihailows; thence it follows generally the valley of the Cur to Kara Su and then along the Caspian to Baku. There are two branch lines, from Rion to Kutais and from Sambredi to Batoum. The length of the trunk line is 557 miles, and the total with branches is 622½ miles.

The stretches between Poti and Kuirih and Mihailowo and Baku are valley and comparatively level ground with light grades and curves of large radii. The section from Michailowo to Kuirili has in its first section grades of 2.2 per cent. with a minimum curve radius of 170.68 m. On the real mountain portion the grades reach 4.3 and 4.6 per cent.

The valley portions are operated by 32 and 42-ton engines with 6 and 8 drivers, while on the mountain part 60-ton 12-wheeled FAIRLIE engines are used, running at about 9 miles per hour with a steam pressure of 60 to 70 lbs. A naphtha train of 30 tank cars is run from Baku to Batoum. The cost of doing this is $174,00 for the 507 miles of comparatively level country; or, 34⅓ cts. per mile. The transport over the mountain costs $78,00 additional; or, $1.56 per mile over the 50 miles of mountain. Naphtha residuum is used as a fuel and is found to be effective and economical.

Since 1872 the Russian government has had in contemplation the rebuilding of the mountain section of this line. Of three possible routes shown in the article of Prof. LORENZ, one has been definitely adopted. This new line involves a long tunnel through granite in the Imerest mountain. The total cost of the new line, not including rails, which are to be re-used, is estimated at 12,286,160 florins (about $3,071,560). The large tunnel will be 2.73 miles long, and is approached by a 1.8 per cent. grade from the Caspian, and a 1 per cent. grade from the Black Sea. The rock is dry and solid, and the estimated cost is about $2,142,000. Besides this there are five small tunnels with a total length of 2303 ft.; and for the construction of these the sum of $208,800 is set aside.

Water cannot be depended upon for compressing air for the drill-plant, etc. During the winter months steam power must be used. The basis is the estimated cost of the work done at the St. Gothard and the Arlberg tunnels; but if Russian engineers have had no experience with tunnels of this length, their estimate of the local conditions must be taken with a certain caution. The average price fixed by them is 1937 florins per meter; or, about $140.87 per lineal foot of a presumedly single-track tunnel. The contractors will be allowed 12 months in which to commence drilling and 60 months to finish the work

THE leading merchants and ship owners, of Boston, want the middle channels of that harbor deepened and widened. Col. GILLESPIE, the Engineer officer in charge, endorses this recommendation, and it is being pushed before the House committee on rivers and harbors.

IN view of the remarkable railway building and present aggregate length of line in the State of Kansas, it is interesting to note that the first railway work done in that State was commenced on March 20, 1860, at Elwood, opposite St. Joseph, Mo. So says the Parsons *Sun*.

ENGINEERING NEWS

TRIBUNE BUILDING, NEW YORK.

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D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Coming Technical Meetings.

Civil Engineers' Club of Cleveland, O.—Regular meeting, Feb. 14. (Mechanical Engineering branch of the club) Secy., C. O. Arey, 31 Blackstone Building.

American Society of Civil Engineers, New York.—Regular meeting, Feb. 15. Sec., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting, Feb. 15. Secy., W. H. Bryan, 709 Market St.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting Feb. 15. Secy., S. E. Tinkham, City Hall.

New England Water-Works Association.—Adjourned meeting, Feb. 15, at Young's Hotel, Boston, Mass. Secy., R. C. P. Coggeshall, New Bedford, Mass.

Western Railway Club, Chicago, Ill.—Next meeting at Grand Pacific Hotel, Feb. 15. "Effect of Magnetism on Watches," E. M. HERR; "Advantages of Six-wheel Trucks for Freight Cars of 60,000 lbs. capacity;" J. N. BARR. Secy., Angus Sinclair.

Engineers' Club of Philadelphia, Pa.—Regular meeting, Feb. 18. Secy., Howard Murphy, 1122 Girard St.

American Institute of Mining Engineers.—Annual meeting at the Institute of Technology, Boston, Mass. Feb. 21 to 25. Secy., A. Raymond, Burling Slip, New York City.

Engineers' Club of Kansas City, Mo.—Regular meeting, March 5. Secy., Kenneth Allen, 19 Deardorff Building.

American Society of Mechanical Engineers.—Meeting at Nashville, Tenn., in April or May. Secy., F. R. Hutton, 280 Broadway, New York City.

Master Car Builder's Association.—Next convention at Alexandria Bay, N. Y; commencing June 12. Secy., M. N. Forney, 45 Broadway, New York City.

American Railway Master Mechanics' Association.—Next meeting at the Thousand Islands, N. Y.; June 19. Secy., Angus Sinclair, Chicago.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reed, Waycross, Ga.

THE description elsewhere given of the design and working of the Panama canal with temporary locks is interesting from the fact of its being the first semi-official news on this point. Our contemporary, *Le Genie Civil*, is not very enthusiastic over the revised project; but it lets the original proclaimers of the advantages of a sea level canal down as easily as possible by referring to the "elasticity" of the lock-canal plan, and claims that the present contingency was long foreseen as a necessary preliminary step in the completion of the "great ditch." The use of the expression "elasticity" is good, and particularly happy under the present condition of affairs.

While our French contemporary claims that a canal *au niveau* is still the hoped for and ultimate end, it wisely abstains from even hinting at the methods by which the canal is to be deepened some 160 ft. in the upper level, and the traffic be at the same time maintained to the standard necessary to pay expenses and leave a surplus for carrying out the original plans. The data concerning the water sheds of the Chagres and Obispo is new and is particularly important in a study of the lock scheme. No particular mention is made of the fact that it is practically either a feast or a famine with the waters of the Chagres river; and that while it is in some seasons a raging torrent, in others it is a comparatively insignificant stream. To secure the necessary annual traffic about 220,000,000 galls. per day must be drawn from the river or the Gamboa storage; and this is no mean draft upon such an erratic stream as the Chagres. The admission that 3,500 H. P. of pumping engines will be required if the upper, and most probable, level is adopted, is an honest one, but it is not particularly gratifying as an item in the working expenses of the canal.

LIEUT. ROGERS in his late paper upon the Panama canal, read before the Am. Soc. C. E., incidentally remarked that the lock scheme would, to a certain extent, do away with the necessity of the construction of the Gamboa *barrage* or dam, and thus save the expenditure of the $90,000,000 which is the usual estimate of cost of this work. According to *Le Genie Civil* this saving is not proposed; for the very good reason that they will need the water stored by that enormous dam to work the canal with locks at all. If the "temporary canal" is to be finished with the $113,000,000 on hand, as is intimated, the building of the Gamboa dam would take out of this sum a very unsymmetrical slice.

We fear the statement of the French engineers to Lieut. ROGERS, concerning the elimination of the Gamboa dam, must be classed with that other statement whereby *derivation* canals on the Pacific slope were to be avoided by the building of an aqueduct which would "tap the sources of the tributaries to the Rio Grande river." And we might add to this same category the most original and ingenious theory ascribed to these same engineers for the slides in the Culebra cut. As described by Lieut. ROGERS, this cut at the time of his visit was 1,000 ft. wide at the top, 600 ft. at the bottom, and 100 ft. deep; the south side of the cut was made up of alternating strata of sand, gravel, loose alluvial deposits and clay, pitched at an angle of about 45°. All of these strata, saving the clay alone, are saturated with water; and very naturally, when the toe of the slope was cut away, the sand, gravel, etc., slid on the lubricated clay stratum and advanced towards the cut. This would really be a serious condition of affairs under ordinary circumstances, and to insure any safety at all from the effectual blocking of traffic by a huge landslide, it would be necessary to remove a vast amount of earth, etc., not contemplated in the original estimate. But, according to the statement made to Lieut. ROGERS, the conditions controlling this particular sliding movement were not at all ordinary. They were very extraordinary in fact, and are accounted for thus:—The displacement of the enormous mass of material in the cut described has "disturbed the center of gravity" of the normal mass to such an extent that dame Nature—as she works on the Isthmus—is making a vigorous effort to restore the general equilibrium of things thereabouts by the gradual shifting of the side hill towards the gash made by the contractors; in time the matter will right itself and the movement cease, and with it all future danger to the canal. While we cannot suppose for a moment that any engineer seriously entertains any such ideas upon a very common and perfectly natural exhibit of the force of gravity, the theory in itself is so very novel that it is worth recording.

But it is very evident that the Frenchmen have not given up the idea of building a ship-canal at Panama. And as a sea level project has proved to be beyond even the wonderful personal influence and persuasive powers of a DE LESSEPS, they will build a canal with locks. We have very little faith in the future deepening of the canal after it is once opened to traffic; but the Panama canal can probably be made as good as any other canal *with locks* crossing the Isthmus, and will have an advantage over all in the shortness of the route. It is possible to eliminate the upper level and reduce the summit to about 126 ft. above sea level; and in that case there is little practical difference between that summit and the 110 ft. of Lake Nicaragua. Under these conditions the "fantastic" ship railway of Capt. EADS might very well enter into vigorous competition with either route, despite the doubts of our French contemporary.

WAS it, perchance, from a deep sense of the eternal fitness of things, rather than from mere oversight, that the arched ceiling of the New York Assembly Chamber was built "so weak that it was liable to fall at any moment?"

WE postpone the conclusion of our discussion of the "Design of the Quaker Bridge Dam" in order to give opportunity for the appearance of a discussion which we are unable to present this week. We trust that no cause will intervene to prevent the early beginning of this much needed work, without which the new aqueduct can fulfil but half its functions, and certainly it seems to us that anything but a solid masonry dam ought not to be thought of under the circumstances, but as the structure is one which, once constructed, ought to stand and probably will stand for centuries, even a little delay is better than to begin construction without *certainty* that the plan adopted is the best which science can devise.

IN our editorial comments on the Haverhill accident in our issue of Jan. 14, we stated that in view of the character of the fracture in the broken wheel on the smoker, it was quite probable that the breakage was some miles old at least. This was contrary to the prevalent theory about the scene of the accident, where it was thought that the broken piece from the wheel must have been smashed into several fragments at the switch, as only one or two small pieces could be found. The editorial was entitled "Quick Confirmation" in reference to opinions expressed in an article a fortnight before which the unhappy accident fully verified, and now the confirmation of our opinion then stated that the first breakage of the wheel occurred some miles back of the scene of the accident is furnished by the finding of the missing piece, evidently the first broken out of the wheel, beside the track not far from Lawrence, about 8 miles from the scene of the disaster.

THE number of advertisements from foreign countries making various inquiries which we have published in the last six months,—a new one from Japan appears to day,—would seem to indicate that our manufacturers are not as fully alive as they should be to the possibilities of foreign trade, and to taking the necessary steps to secure it. It is but a bagatelle compared with our internal trade perhaps, but it certainly has limitless possibilities, and the time would seem to have already come when our manufacturers might at least take a little more pains to keep foreigners advised of what they have to sell, if nothing more. The Japanese notice which appears elsewhere is one well worthy of their attention.

THE State of New Jersey is to be congratulated upon the possession of the best set of maps and the most complete data concerning its topography of any State in the Union. And it should be further congratulated upon

having put the conduct of this survey into the hands of State Geologist Prof. GEORGE H. COOK, and his able assistants. As shown in the note upon this survey elsewhere given, the results achieved for a comparatively trifling outlay have been remarkable and in themselves bear strong testimony to the executive ability and careful supervision of Prof. COOK. We have more than once referred to the artistic and at the same time useful manner in which this survey has been presented to the public in the Atlas sheets, and must again say that they are, beyond compare, the handsomest State maps published, and the most useful to engineers and geologists generally for the information contained in them.

When it is considered that the collection of this data and its presentation in such excellent shape has cost but little more than *one cent per acre*, it is a reproach to every other State that hesitates to inaugurate or delays the completion of a similar good work. In this day of great public works, of railroads, drainage and water supply, an accurate and complete topographical map is a basis of operations that cannot be too highly valued. It is a public necessity in fact, and no reasonable cost of completion should stand in its way anywhere. Prof. COOK has practically demonstrated how good State maps can be made at a cost which is nothing as compared with their public value and it is to be earnestly hoped that all other, States will push forward their surveys under way, inaugurate new surveys and present the results in as acceptable a shape as these New Jersey maps.

WE had hoped to be able to discuss this week as fully as its importance demands, Mayor HEWITT'S rapid transit project for New York City, the main points of which were noted last week. The main features of the project seem to us exceedingly meritorious, as we have stated, but there are some very objectionable features, as notably the provisions for down town travel, which seem to us extremely inadequate for the requirements. In order to show this graphically, by some diagrams for which we have no room this week, we postpone further comment on the message to a later issue.

THE third revised and enlarged edition of "The Economic Theory of the Location of Railways" being about to go to press, *immediate* advice of any typographical errors discovered and not yet reported will be a favor.

Printed lists of the typographical errors corrected in the first second and third editions, will be mailed shortly to those applying for them. They are not very numerous nor important.

The People and Prospects of Mexico.

Mexico is again becoming prominent in an engineering way, especially as respects railways, and the chances are good that within the next twenty years it will become more so. Perhaps there is no foreign country of any prominence as to which Americans in general have less clear ideas; and in presenting the view of the beautiful monument recently erected in Mexico, which appears in this issue, it has occured to us that it may be of general interest, and perhaps of value to many, to form something like a clear idea of what the people were and are which the monument commemorates, so far as can be judged from a four years' residence in Mexico, during which the present writer was thrown, in the line of duty, into more different towns and sequestered hamlets of Mexico than has perhaps fallen to the lot of any American before or since, or certainly to the lot of any of those who have undertaken to describe the character and habits of the people.

To form a true mental picture of Mexico, or a just idea of the probable future of engineering enterprise within it, an American must be on his guard against founding his ideas of what is and will be there on his experience and observations here, for both the country and the people differ radically; so radically that the differences which exist between the various sections of our own country become trifling in comparison. The most important question for the future of any country is the kind of people which live in it, for one need not go to New England and Brazil to learn that in the long run, it is the people which make a country rich, and not the country which makes a people rich. What then are the people of Mexico?

They are a mixed yet in a sense homogenous race of descendants of the Spanish conquerors and the conquered Indians. The statistics of all kinds, even of aggregate area and population, are very imperfect, and all of them are more or less based on guess work, in detail if not in the aggregate. Not even an attempt has been made to accurately enumerate the number of each race, and the estimates made differ widely, but after all not radically, from the following:

Of pure Spanish or white blood.	1,000,000 to 1,500,000
Of pure Indian (mostly Aztec) blood	5,500,000 to 5 000,000
Of mixed blood,	3,000,000 to 3,500,000
Total population.	9,500,000 to 10,000,000

Of the relation between these races and of their relative character we have in some degree a close parallel in the white and black races of our Southern States, but with radical differences. The Mexican Indian has little but his name and color in common with his namesake of the North, whom he both hates and fears when thrown in contact with him. Like the negro—even more than the negro in some respects—he is gentle, peaceable, submissive, unambitious and measurably industrious. Centuries of oppression have bred in him the negro's vices of petty thieving and lying, which by the momentary annoyance which they cause to Americans who first come in contact with him, are apt to blind them to his many admirable qualities and cause them to unduly underrate him.

As in our Southern States, the white and colored races live together on peaceable and even friendly terms and strong attachments exist between them, but it is in part for the same reasons—that the Spaniard is everywhere recognized as the superior. He holds nearly all the property, he opens the mines, he keeps the shops, he does all the voting, or to speak more truly, manages the caucuses which manage the election returns, since of voting proper there is none, although universal suffrage is the law;—in fact, he controls every industrial and political interest, so that it is his characteristics, in the main, which have made the country what it is, and to him belongs the credit or discredit.

But the parallel may easily be pushed too far. The Indian is a more manly man than the negro and his manliness shows itself not only in his instinctive and invariable courtesy, which never fails, and of which many amusing proofs might be given, but in a certain quiet but stubborn dignity of character which will not let him submit to wanton indignity. *He will not be struck*, and if he is struck will almost certainly seek ultimate if not immediate vengeance. In the early days of conquest, to be sure, they were subjected to cruel oppression of every kind, but only when kept close prisoners, and their conquerors soon abandoned the attempt as unprofitable and fell back upon the system of *peonage* instead, which has been only in recent years abolished and which enforced "labor and servitude" not by physical compulsion but solely by applying the scriptural command, "He that will not work neither shall he eat" except just enough to keep him forever in debt; the debt descending from father to son and binding a man to the service of his creditor until the debt had been discharged. Practically the system is in force to day although without warrant of law.

Perhaps because of this one manly characteristic of the Indian it has resulted that although the relations to each other of the two races as a whole are as stated, it is with many individual exceptions. There is no such sharp and impassable line between the two races as such, as exists between the white man and the negro in the south. The Spaniard despises the Indian, not because he is an Indian, but because he is a hewer of wood and a drawer of water. If he once rises above that condition, he takes his natural place in the ruling class and is no longer despised—and many have done this. JUAREZ, perhaps the greatest man which Mexico has ever produced, who would have been a great man anywhere, was an Indian of pure blood. One of the ablest lawyers, perhaps, in the republic to-day—certainly an able lawyer—is also of pure Indian blood, and would be noticeable on Broadway or anywhere for the intellectual power expressed by his countenance. Intermarriages even between Spaniards and Indians of pure blood are, if not frequent, certainly not unknown, and the fact in itself carries no stigma.

It naturally follows that, between two races in this relation the fact of mixed blood—the intermixture dating back often two or three centuries, it should be remembered—would not in itself carry with it any such stigma as an admixture of negro blood does here. On the contrary, it carries, or tends to carry, the offspring half way toward the ruling class, and he gravitates toward one or the other, according to his natural character. Illegitimacy, it is true, carries its stain there as here, but the illegitimacy is often so far back as to have been forgotten and is no longer taken for granted from the fact of mixed blood. Men of mixed blood, consequently, are found in great numbers in all ranks of society from the highest to everything *but* the very lowest. In the peasant class they are never found and the disadvantages inseparable from their origin have caused the most dangerous and vicious classes of the community to be formed among them. They have been the highway robbers and formed the little bands of insurgents who have kept the peaceably disposed majority of the community in perpetual turmoil, but they have also helped to form—and in large numbers—a peaceable and energetic middle class.

From the mixture of all these classes it has resulted that after all, in spite of the wide difference between the extremes, Mexico has a tolerably homegeneous population in one sense, in that there is no sharp line of demarkation nor impassable gulf anywhere, from the highest to the lowest.

Considering their industrial capabilities, it will seem reasonable to believe, and it seems beyond doubt true, that the lower two-thirds of the population are very much what circumstances have made them, and ought to be easily capable of more efficient and productive labor under better influences and with the stimulus of a more advanced civilization. They are apt although not very hard working mechanics, have strongly marked artistic and imitative capacity, have tolerably good muscles and only need to be made to feel more wants and to be put in the way to gratify them by better service, to render better service if they choose. The danger is in their lack of ambition.

At present they feel no wants and live in—measured by our standards—abject squalor, on 18 to 25 cts. a day, out of which they pay enormous prices for everything which they consume, which is practically only corn and (if the family is not too large) beans, with a little lard, a great deal of *chile* or red peppers, and a few yards of coarse cotton muslin. It is an amusing and to us incomprehensible fact that the three great staples of corn, beans *and red peppers* stand very nearly on a par in cost in the statistics of food supplies, and are vastly ahead of meat or any other food staple whatsoever. The *peons* have no beds nor furniture of any kind, beyond a board or two, no knives and forks, no floors, nor any of the luxuries which the poorest have here as a matter of course. But those who watched with any attention how kindly they took to earning 31 cts. per day on the railway, and how much harder they worked for it than they ever had worked before in their lives, will not believe but that they can eventually be made to feel the spur of much higher necessities; especially if they know (as few Americans do) that by paying 50 cts. per day picked gangs of tracklayers were obtained which experienced track men declared (perhaps over enthusiastically) could not be bettered man for man in the United States.

There is therefore sound ground for believing that the lower two-thirds of the population can and will earn far more, perhaps several times moreper day than now, and assuredly if they earn it they will spend it. Many more of them than now will become skilled mechanics, and all can be made to do more labor, which if better directed will be far more productive. The great amount of labor now wasted in doing service which machinery or modern appliances would do far better will be released for more productive work. As all this means just so much more earnings to spend in railway travel and other luxuries, it alone gives hopeful and reasonable promise of better days in the near future.

Nevertheless, the Mexican *peon* with all his good qualities, is too gentle, yielding and indolent, to ever become on even the smallest scale a "Captain of Industry" except in isolated instances; and it being practically certain that, from an industrial point of view at least, he will be something like clay in the hands of the potter, the interesting question arises, who is to be the potter? The opinion is quite general in this country that, as a natural consequence of the recent commercial invasion of Mexico, the American is to be the potter, as a matter of course, and that the old Mexican governing class will be commercially if not literally "driven to the wall," as it is supposed to have been in the old Mexican territory now a part of this country. Those who have most carefully and intelligently studied the actual situation do not share this view.

It is far more probable that on the present upper class, which now controls the *peon* labor, will chiefly depend the progress of the people as a whole, and, perhaps no one question about Mexico is more misapprehended by Americans than the character of this upper class. Unhappily, when the two races are thrown in contact, it is the worst side of each which in general obtrudes itself most upon the other. The Spanish Mexican is above all things courteous and considerate in his manner, and he is quite ready to admit that he has much to learn, which he is anxious to learn, from the American, but he is not always sincere or even truthful and it is the habit of ages with him to make haste slowly and work with the hands of other men. On the other hand the American is a good fellow at heart, but with the maladroitness of his race he makes little or no effort to adapt himself to the people he is with, and looks on every difference of character or custom as a plain mark of inferiority. Thus the American is apt to look on the Mexican in his heart as a lazy, lying cumberer of the earth, while the Mexican looks on the American as an insufferably conceited and ill-mannered worshipper of the almighty dollar, and he regards him—especially in Northern Mexico where the whole working force and not merely the higher officers were "Americans"—with mingled feelings of fear, hatred and contempt. We can admit that the Mexicans' feeling is an unjust one, but it is not so easy to admit, what is yet the truth, that the Americans' view of the Mexican is quite as unjust, if not more so. For if we are to measure the capabilities of a people, not by what they are at a given moment, but by the rate of progress which they are making, as is but just, and if we compare what Mexico is to-day with what it was ten or twenty years ago, then certainly the Mexicans are entitled to claim high rank among the most progressive peoples in the world. Within that period they have abolished *peonage*, introduced almost perfect freedom of conscience and of the press, put down all lawlessness by armed bands and individuals—so that Mexico is to-day one of the most law-abiding countries in the world;—established free public schools in every little hamlet and village; adopted perhaps the (on paper) most perfect and enlightened constitution in the world, corrected grave and dangerous abuses in the monopoly of land and political power by the church to which they still adhere, greatly increased the financial purity of their government, secured the rapid construction of railways at minimum cost to the State on terms the shrewdness and wisdom of which, as offering just enough inducement and not too much, is shown by the results, and which have greatly added to the industrial and commercial activity of the country.

All this can hardly have been accomplished in so a short a time without the possession of sterling national qualities. Their history from 1821 to 1876 seemed most discouraging, and seems to indicate great lack of capacity for self-government; but we have only to look back a few hundred years to find that such long periods of disorder are often by no means discouraging symptoms, but rather in the nature of storms which clear the air, or of severe illnesses in the life of individuals; a necessary step in the process of evolution from a lower to a higher civilization. In the history of a race a hundred years is a short time, and the race which has only to go back a few decades to its DICK TURPINS and CLAUDE DUVALS at the very gates of London, and to roads axle deep with mud as its only means of transportation, is ill entitled to look down on the Mexicans for their bad and—until quite recently—"insecure" (as the Mexicans say) roads. It now seems quite safe to say that they have permanently entered upon the era of peaceful industrial progress which we entered upon a hundred or more years ago. There has been a great and radical change in the whole atmosphere of the country. Therefore, the mere fact that they have been a little slow about beginning it does not in itself prove that they are not fitted and able to carry on the works of peace, under their own management in the main, with only casual and incidental assistance from the outside world. And it seems probable that for a long period of years at least, the American will *not* become the ruling power in Mexico, either industrially or politically, but that the upper classes of Mexicans will retain the control in both respects for these reasons:

(1.) They are unmistakably filled with the *desire* for progress, and with national and personal ambition; an important element, even if—measured by our standard—they do not seem ready to exert themselves sufficiently to attain it.

(2.) They understand the management of their working classes and (probably) getting the utmost possible out of them better than the American will ever learn to. They have a natural tact for management of this kind, as evidenced by what they have already accomplished (which is certainly not a little) and by their ability to accomplish anything by methods which would lead an American to ruin.

(3.) They are sharp traders, wire-pullers and politicians. In our American Mexican States they fully hold their own in these matters against American competition. They get more than their share of the offices, take and faithfully execute contracts, carry on competitive business successfully, and are not by any means driven to the wall. As the Mexicans of these regions are, on an average, of a distinctly inferior class to those of Mexico proper, it will be far more difficult for Americans to supplant them on a large scale in their own country.

We have only to look at the rapid development which is now going on in Buenos Ayres and Chili to see that the Spanish American race is quite capable of initiating such a movement under favorable conditions. The people of the first named country especially, who have been styled "the Yankees of the South," are showing marvellous energy in developing their country. Something like this, we believe, is to take place in Mexico. In spite of temporary drawbacks the country is destined to great, if slow, development, and in our generation, this development will be chiefly in the hands of its own people.

The New Jersey Topographical Survey.

We are indebted to State Geologist GEO. H. COOK and to Mr. C. C. VERMEULEE, Topographer in charge, for advance proofs of the report on the topographical survey of the State of New Jersey. The field work is now completed, and the operations of the past year were confined to checking and revising the map of 1882, covering the northeastern part of the State, which was originally compiled from other surveys. This ground is now covered by original surveys. The running of levels has been continued, and the final report will contain a complete list of these. The magnetic survey of the State has developed some curious facts as to the occurrence of local attraction, and the publication of this data will not only be of scientific interest but also contribute to the accuracy of local surveys and aid in retracing old lines, etc.

The mapping and engraving is going on, and a small map of the State on a scale of 5 miles to the inch is now engraved and issued. At this date all of the maps on the inch scale are engraved excepting a small portion of the revision work on Atlas Sheets Nos. 6 and 7. This work will be finished in March, and the Atlas will then be completed.

This State survey was commenced in 1877, with the design of issuing a complete topographical map as accurate as a scale of one mile to the inch would admit. It is the pioneer topographical State survey in America, and the engineers and geologists who have worked over the parts completed have borne testimony to its practical value.

The total amount paid out for salaries and expenses of the topographical corps in the field and office has been $59,892.95. Of this amount $5,143.37 was devoted to work not chargeable to the topographical survey proper, and should be deducted from the above amount. With this deduction the total cost amounts to $6.93 per sq. mile, or $1\frac{1}{12}$ cts. per acre. This includes triangulation covering 2,000 sq. miles. By availing itself of the offer of co-operation with adjoining States and the national survey

the State of New Jersey has secured these results at a cost to itself of but half the above sum, the remainder of the expense being borne by the national organizations.

Primarily, the control of this work rests on a triangulation by the U. S. Coast and Geodetic Survey, filled out and extended so as to include a total of 458 stations determined with absolute accuracy. These stations are very close together along the sea coast and large rivers, and average one to each 25 sq. miles in the interior. The next step was the running of traverse lines over the whole area at an average of 2.53 miles of traverse lines to each square mile of territory, which is equivalent to a net work of rectangles having sides of four fifth of a mile. From this network all important points of topography were located by traversing with a prismatic compass and pacing, the pacing being checked out on a main traverse line opposite to the one from which the start was made. All streams of importance were thus followed and all summits and ridges thus visited. It has been found that an experienced topographer can by these means secure results as accurate as the map scale can exhibit. Heights have been determined almost entirely by the spirit-level, running between a net-work of primary levels, and the elevations given can be relied upon to the nearest foot. For practical use this has been deemed one of the most important features of the survey, and some extra expense has been incurred to insure accuracy.

A summary of the total work done in this topographical survey shows that the area covered was 7,894 sq. miles; in leveling, 15,689 miles were run 19,724 miles were traversed with the odometer, and the total number of stations was 215,255.

The following time record of the survey will serve to show the proportion of labor devoted to each portion of the work. The time given is in day's work of one man. The topographer in charge carried on triangulation and other field and office work in person, supervising the work of the party at the same time, as much as possible. When the whole of his time was required for administrative duties this time has been charged to supervision, otherwise to the class of work in which he was mainly engaged.

	Days' Work.
Leveling and sketching simultaneously	8,082
Sketching, without leveling	760
Primary leveling, without sketching	708
Traversing, with odometer	2,145
Transit traversing	713
Triangulation	467
Office work, including platting and also much miscellaneous work incidental to all surveys.	4,159
Supervision	894
Total	17,926

No reduction is made for Sundays or for stormy days in the above record. It includes all of the time devoted to work which appears in the results of the Topographical Survey proper, including a considerable amount of miscellaneous office work having no bearing on these results.

Railroad Building in Colorado and Utah.

If present indications can be relied upon, the coming season is likely to witness some extensive railroad construction in southern and western Colorado. The Denver & Rio Grande system has at present the monopoly of the traffic of southern Colorado, a region which includes some very fertile valleys and some mining camps which furnish a good deal of traffic. We are creditably informed that the recently incorporated Rio Grande & Utah Railway company is no paper corporation, but a company backed by the principal officers of the Santa Fé system, and that the line now under survey from Algodones, N. M., to Durango, Col., and the Montezuma valley will certainly be built at once. The distance is about 200 miles, and the route is through a country said to be favorable for construction, but which it would seem probable cannot furnish much traffic for some time to come. The company's charter permits an extension to Salt Lake City, Utah, a line which as we have stated in a recent issue, could hardly prove a profitable enterprise unless in a strategic way. It now transpires, however, that there is at least a possibility of the Denver & Rio Grande Western managers forming an alliance with the Santa Fé. This would give the Santa Fé a line to Salt Lake City, without building 300 miles across Utah deserts, and would warrant the building of the line from Algodones. In direct connection with this rumor is to be considered the extension which the Denver & Rio Grande managers have publicly announced their intention of building from their terminus at Glenwood Springs to Salt Lake City.

There is no doubt that the great struggle for supremacy in the Southwest is to be between the Gould and Santa Fé systems. The Denver & Rio Grande has recently shown strong indications that it was being drawn under the Missouri Pacific's wing, and it is now reasonably certain that before long it will be operated as part of the Gould system. It is also known that the numerous rumors of a projected Gould line from Salt Lake City to the Pacific have considerable foundation in fact. It thus becomes necessary in order to complete the link in a Missouri Pacific line to the coast, either to gain control of the Denver & Rio Grande Western or to build a new line from some point on the Denver & Rio Grande. An alliance of the Denver & Rio Grande Western, with the Santa Fé may explain the sudden determination of President MOFFAT to push the Glenwood Springs extension through to Salt Lake.

A General Bridge Bill for Western Rivers.

The Board of Army Engineers appointed to draft a general bridge bill for the Mississippi, Missouri and Illinois rivers, have been in session for some weeks in St. Louis and adjourned on Jan. 31. The board was composed of Lieut. Col. SUTER, St. Louis, President; Maj. A. MACKENZIE, engineer in charge of Mississippi river improvement between St. Paul and St. Louis; Maj. A. M. MILLER, in charge of Mississippi river improvement between St. Louis and Cairo, and Maj. THOS. H. HANDBURG, in charge of the Missouri and Illinois river improvements, with Lieut. BINGHAM, Recorder of the Mississippi River Commission, acting in like capacity for the board.

The bill as drafted out is to provide for granting the right to build bridges across the Mississippi, Missouri and Illinois rivers, and to do away with all special bills for that purpose. It will be similar to the general bill governing the bridging of the Ohio river, but will, it is believed, throw still stronger safeguards about the river interests while not encroaching upon other business involved. Under the Ohio river general bill, when a company desires to construct a bridge all that is necessary is to select the site and notify the Secretary of War, who appoints a commission or board to investigate and report upon the matter, and if the proposed bridge is not deemed detrimental to navigation, the right to build is granted by the War Department, thus doing away with much of the red tape, and the necessity of getting a special bill through Congress.

The passage of this bill will seriously interfere with the prospects of parties who have been securing bridge charters with the sole view of disposing of their rights for a price. One charter for a Mississippi bridge is said to be held at the round sum of $250,000. Under this bill any one can build a bridge who has the approval of the War Department.

CORRESPONDENCE.

Proposed New Grades of the Am. Soc. C. E.

EDITOR ENGINEERING NEWS:

I send you enclosed a letter from a former assistant of mine, now an assistant on one of our leading trunk lines, which explains itself. The writer is a native American, a clever and industrious man, and his position in the letter is well taken. It is typical of that of a great many young engineers. My present assistant is in the same fix; he is too high up to be willing to enter as Junior, and not fully qualified for full membership, though better capable to take charge of work than many Members I know.

Yours truly,
M. AM. SOC. C. E.

[The following is the letter enclosed, which carries its own moral, without further comment.—ED. ENG. NEWS.]

DEAR SIR:—Is it possible for an outsider to purchase or obtain any of the papers of the Am. Soc. C. E.? I am very anxious to get one of them.

If the Society changes the Junior grade to one of higher qualification, and fixes the age limit at 30 years for full membership, I will make application for this new grade. I do not care to enter as a Junior, since it is no credit to a man, and my experience has been much greater than any Junior requirements, although not yet sufficient for full membership. If the new grade is adopted, there will be no discredit for me to enter it since I am under 30 years of age.

Action of Sea-water on Wrought-iron Piles.

PROVIDENCE, R. I., Jan. 28, 1888.

EDITOR ENGINEERING NEWS:

Your item, in ENGINEERING NEWS of even date, on "The Action of Sea-water on *Cast*-iron Piles," contained one of those stray bits of information which theory does not cover.

Can you refer me to a similar one which will give me the action of sea-water on *wrought*-iron *during a period of years*? Perhaps some subscriber has made observations, and would be willing to impart the result. Yours truly, GEO. B. FRANCIS.

[The usual opinion is that the effect of sea-water on wrought-iron is destructive; as the oxydized parts scale off, and expose new surfaces to be acted upon in like manner. We cannot now refer to any experiments extending over a considerable period of years, but should be happy to publish any such made by our readers.—ED. ENG. NEWS.]

Action of Salt Water on Cast iron.

CHICAGO, ILL. Jan. 25th 1888.

EDITOR ENGINEERING NEWS:

Will you please inform me, through your paper, as to the correctness of the following statement regarding cast-iron.

Sometime since, while engaged in the South, I was informed by an experienced diver, that cast iron, when left for a period of ten or fifteen years in the sea, became so soft on the outer surface that it could be readily cut with a knife.

This diver had visited many of the vessels sunk during the Civil War, and in many if not in all instances found such to be the case. I shall be pleased to learn if there can be any foundation for such a statement. Respectfully R. B. S.

[Some kinds of cast-iron become soft in sea water, while others do not. In our last issue we published a short article on the subject. By referring to "Iron, cast, salt water, effect on" in the index of "Trautwine's Pocket Book" our correspondent will find a further reference to more definite information, and we may add that this and other like sources of information, while not the equal of ENGINEERING NEWS in infallibility and omniscience, are (or ought to be) nearer at hand. ED. ENG. NEWS.]

Confusion of Station Names.

Terre Haute & Logansport R. R.

TERRE HAUTE, Ind., Jan. 31, 1888.

EDITOR ENGINEERING NEWS:

I have read with interest your comments on the revision of station names, to avoid confusion in telegraph orders, and heartily indorse your plan of adding the telegraph call to the station name in these cases; but your statement as to the call "rarely having much resemblance to the name, is at variance with the facts. Witness a few sidings, on a certain road, and their call,—where they have one; viz. *Malcolm* (no call) Farrington "Fu," Dennison, "Du," *Marshall*, "Mr," *Martinsville*, "Mu," Casey, "Ca," and so *ad infinitum*. In my four years experience as an operator I knew of the three names, in italics, being confused by train men repeatedly, until their attention was called to the proper reading by the operator. The calls, in this case, would not be much assistance. A reform everywhere is needed, and especial care should be taken in the naming of new stations.

CIVIL ENGINEER.

[Practice on various roads differs no doubt, but purely arbitrary combinations, like *Xd*, *Fl*, *Zy*, etc. etc., for names which do not even

contain those letters, are in very common use, and the number of cases where two stations with names at all similar have calls which are likewise at all similar is, we think, very small. —ED. ENG. NEWS.]

Routine and Safety.

NEW YORK, Jan. 29, 1888.

EDITOR ENGINEERING NEWS:

I have just read with great interest your editorial note in issue of 28 inst., regarding the steamer collision in NewYork bay, particularly in respect to the employé who turned the dynamo switch to the right, instead of to the left as instructed. Possibly you say this very anxiety and fear of error had been his ruin," but is this all ?

It has been said in regard to teaching a horse, that you must proceed on the assumption that he has but one idea at a time; that he is incapable of adding or subtracting one "thought" from another; and that therefore, having taught him, say, not to fear an object on one side, you reverse the position and teach him from the other side. I do not pretend to decide as to the fact, but there appears to be at least considerable "horse sense" in the proposition; which has a present application to the *genus homo* as well as to those of inferior intellect.

Now, in the case of the switch operator, the undoubted intention of the teacher was to most fixedly impress upon the mind of the pupil *one* thing, namely: to turn the switch only to the *left-hand*. The question is, was the instruction properly given.

That there is a left implies that there is a right. It may be fairly assumed also that the teacher distinctly gave the negative instruction, do *not* turn the switch to the right; and furthermore that at the time of instruction and at the instant of signaling both stood face to face.

What did all this mean to the mind of the operator whose will had to act to decide upon and do one thing? It was necessary to select the volitional impulse from at least five distinct impressions, viz.: "I must await the signal; I must *not* turn to the right; I MUST turn to the left; this side is the right hand; that side is the left hand." Between the cross-flashes of intended effort, one misshap neutralizing the other, manual education may have turned the balance and the hand may have acted, without consciousness, in the direction it had been taught. Besides, there is an additional element, though one not capable of so complete demonstration, that presuming both were facing each other, the operator, through "unconscious cerebration," may have turned the fatal switch to the *left of the signal sender*.

Of course after failure it is easy enough to criticise, but there may be future immunity in the present suggestion that the chances of such an error would have been greatly diminished had the teacher simply said to the pupil, when I signal to you, *turn* THIS *handle in* THAT *direction*.

This simple instruction would have reduced the chances of error from four or five to one; as the act to turn the switch was a sequence to the word of command in both cases; after that, however, in the one case there was legitimately but *one* impression; in the other case, there may have been *four or five* impressions.

The capacity to select one idea from many: to do this quickly and with certainty as to its correctness, and then to combine it with an act, is what occasionally dubs a man "hero" without his knowing it; because to him it seemed easy enough.

It would seem to be a fair deduction that safety lies in instructing your operators as you would your horse—one side at a time; and that the association of *place and things* are infinitely more clear and distinct to any mind than the memory of any arbitrary term.

Yours truly,
JOHN THOMSON.

Erosion from Rotation of the Earth.

MADISON, Wis., Jan. 25, 1888.

EDITOR ENGINEERING NEWS:

Noticing the note in your issue of Dec. 31, as to the alleged influence of the earth's motion on railroad trains running north and south, as quoted by Mr. GOODRIDGE from MAURY'S "Physical Geography of the Sea," it appears to me that, perhaps this idea is suggested by the following statement made by DANA in his "Manual of Geology," page 650, paragraph 4:

Effect of the Earth's Rotation on River Erosion." The earth's eastward rotation, together with the increase in rate from the pole to the equator tends to throw the waters of streams in the northern hemisphere against the *right* bank (the right looking down stream), and, in the southern, against the *left*. Although the ratio between the impact on the two banks differs litt'e from equality, the difference is sufficient to cause an undermining of earthy deposits and make the bank struck the high and steep one, and the other low.

The expression for the ratio at the depth z, is $g z + b v w \sin l : g z$, in which b is the breadth of the stream, v its velocity, l the latitude, and w the angular velocity of the earth about its axis (Cambridge Mathematical Tripos, 1875). With a stream 1,000 ft. wide, the ratio for the impact on the two sides at a depth of 10 ft. would be as 461 to 460. The effects have been observed in many parts of the world where the deposits intersected are earthy, and the pitch of the surface is very small and has the direction of the stream. They are marked along the great rivers of Siberia and Russia, or others in Southern France, on the streams intersecting the low land of the Atlantic border of the United States (KERR), and on those of southern Long Island (E. LEWIS.)

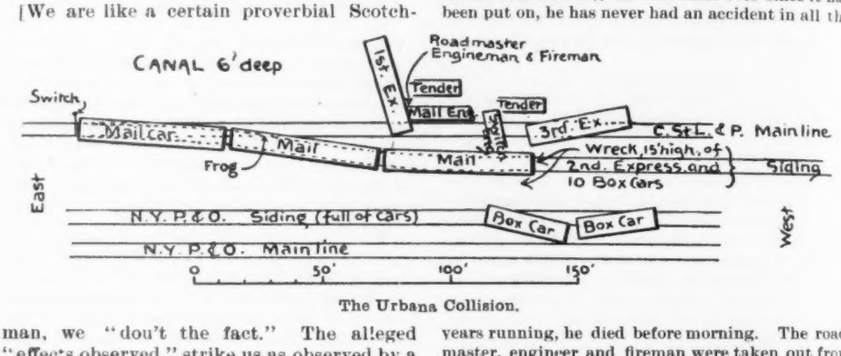
Yours truly, H. S. MACM.

[We are like a certain proverbial Scotchman, we "dou't the fact." The alleged "effects observed" strike us as observed by a process not unknown in many other kinds of scientific work. The theory is evolved first from the inner consciousness, and the facts are "observed" to fit it. An imaginative observer with a scientific bee in his bonnet can find any amount of confirmation of the above theory on any north and south river by this simple process. All extra erosion on the right side, is due to the rotation of the earth; all on the wrong side is due to local causes; but we doubt if he can by any other. The beautifully simple formula is very imperfectly given; the signification of g (which does not appear to be the conventional $g = 32.16$) and the units of velocities are not given. Whether or not it is correct, we cannot undertake to say, but that there is any river in the world in which the *legitimate* effects of a difference of $\frac{1}{480}$ in the lateral impacts (small at best in a straight channel) can be observed we very much question. If the effect is measurable, all north and south rivers in alluvial bottoms, like the Mississippi, should be working their way westward. Is there the slightest evidence of this fact anywhere? To us, the Society on the Stanislaus seems the proper body to discuss the allegations of both Lieut. MAURY and Prof. DANA.— ED. ENG. NEWS].

The Urbana Collision.

EDITOR ENGINEERING NEWS:

Train No. 7, consisting of Engine No. 453, three Adams' express and three mail cars, and running on the Chicago, St. L. & P. Ry. (Panhandle), which arrives in Urbana at 3.53 P. M., making the run from New York to Kansas City in 36 hours, was on Tuesday, January 31, 55 minutes late. When running 63 miles per hour it collided with a yard engine producing the wreck shown on map herewith. The yard crew, having some switching to do at the east end of the yard, concluded to try to do it on No. 7's time, trusting to luck to get in on the siding. The switch engine could not kick some cars back that were standing on the side track before the mail came in sight around the curve, and up the hill. The two engines struck at or near the switch, which is 200 ft. from top of grade. The engine of mail train must have ridden the switch engine for a distance of 175 ft. before striking the freight cars, which threw the switch engine across the track, and the mail engine parallel to and on the south side of main track into what is known as the canal, piling the second express car and 10 box cars on the main and side tracks 15 ft. high; also knocking over two freight cars standing on the N. Y. P. & O. siding so that they had to be sawed off to clear that main. The first express car came to rest with back end in the canal and front end resting on the engine of the mail train; the third express car took a leap over the whole wreck and landed 20 ft. on the west side of it. The first postal car was forced ahead into the pile of wrecked freight cars. The postal clerks were shaken up, but not badly hurt. The express messenger was locked in the third express car, and when that car took the leap he was knocked through and was very badly hurt. The roadmaster, FRANK SHADE, was riding in the engine cab, and was taken out dead, having one leg cut off. The fireman died in a few hours from scalding. The engineer, FRANK BROWN, had been running on the road for 19 years; he has been running the fast mail ever since it has been put on, he has never had an accident in all the years running, he died before morning. The roadmaster, engineer and fireman were taken out from behind the steam dome and from the bottom of the ditch.



The Urbana Collision.

These are the facts as nearly as could be learned, the measurements having been made the night of the wreck, and the photograph taken the next morning.

Yours truly
W. H. L. T.

[The rails were very badly gouged by the lateral action of the flanges caused by the collision. At about 40 ft. from the point of collision, a piece about 19 ins. long, $\frac{1}{2}$ ins. deep and $\frac{3}{4}$ ins. wide was cut out of the side of the rail by the flange, and 8 ft. back there was another smaller cut 10 ins. long.

We do not reproduce the photograph, as it is dim and without special technical interest. In fact, the warning of the whole accident is simply against a very common form of carelessness in operating.—ED. ENG. NEWS.]

Bridge Guard Rails.

ST. PAUL, Minn. Feb. 3, 1888.

EDITOR ENGINEERING NEWS:

Referring to the current discussion on bridge guard rails in your paper I desire to call your attention to a point which seems to me to be very important, and which I do not think has yet been brought out.

The bumping posts should be placed considerably farther from end of bridge than 20 ft. 6 ins, the distance shown in the sketch on page 61, and which you approve of, except as to relative position on the posts and the guards proper.

Should a derailed car, moving at even the slow speed of 15 or 20 miles an hour and with half or three-fourths of the train following, strike the bumping post, can it be reasonably expected that the wreck would not extend farther than 20 ft. beyond the post and strike the bridge? I think not.

I believe in inside guard rails and the re-railing frogs or guards, but would place the latter 150 ft. from end of bridge and have the inside guards commence thereat, and the bumping post, *if used*, to be so placed that a derailed car would strike it imme-

distely *after* the derailed truck had passed the re-railing guard.

In case of the car tipping sidewise, as mentioned by Mr. DAILEY, is the post high enough to catch the car body if only 4 ft. above rail?

Respectfully, C. F. LOWETH.

[It is undoubtedly preferable to place the post farther away, but better where it is than nowhere. Local circumstances must govern this to some extent; but standing where it is it would probably prevent cars going into the river. The post is likewise rather low; it should preferably be a foot higher.—ED. ENG. NEWS.]

Super-elevation and the Haverhill Disaster.

Chandler Scientific School,
HANOVER, N. H., Jan. 27, 1888.

EDITOR ENGINEERING NEWS:

You seem somewhat disposed to take me to task on account of my comment that at the Haverhill accident there possibly was not a sufficient elevation of the outer rail for the speed of the train. Now, I suppose, of course, you do not understand me to convey the idea that the outer rail should be elevated for the speed of every train, as that would be impossible. I meant to say that the rail was possibly not elevated sufficiently for the speed of the fastest train that now goes around that curve.

All the engineer's pocket-books in my possession, viz., HENCK'S, SEARLE'S and SHUNK'S, also PARSONS' "Track," give rules making the proper elevation vary as the square of the velocity, or nearly so. Now, if that curve was elevated for a maximum velocity of 20 miles per hour, and the actual maximum of the fastest trains *now* is 40 miles an hour, evidently, according to the rules of these authors, there was something wrong about the building of that portion of the track. HENCK'S formula for the elevation of the outer rail is $e = \frac{g\,v^2}{32.2\,R}$, where e is super-elevation, g, gauge of track, v, velocity, and R, radius of curve. SEARLE'S rule is the same, as is also that of PARSONS. All say that the velocity to be used should be that of the fastest train, and all give, I believe, no other reason for elevating the outer rail except that of overcoming the centrifugal force. SHUNK gives a different rule, but the results are about in the same ratio. Take for example, a 6° curve with a velocity of 20 miles per hour. According to his tables the proper super-elevation is 1½ ins., and for a velocity of 40 miles an hour the elevation given is 4 ins., which makes the elevation of outer rail increase in a greater ratio than the square of the velocity. If there are other important forces acting upon a truck it would seem as though they ought to consider them.

Now I am aware that Mr. WELLINGTON in his "Railway Location" says that centrifugal force has only a minor effect in throwing a truck against the outer rail and in producing derailment. He has investigated the subject and the forces which tend to press the flange of the outer wheel of a truck against the corresponding rail, and I have not, and of course he can speak with more assurance than I. It nevertheless, does seem from outward appearances that the momentum of a heavy train moving at a high velocity must be a tremendous force in propelling the same in the direction of a tangent to any curve, and thus tending to produce derailment, and that if the truck still presses hard when the outer rail is elevated, according to what have been common rules, it is because the rail is not sufficiently elevated thereby. You say, "the great force which presses the outer leading wheel of the truck against the rail comes from the tendency of the wheels to roll in a straight line, a matter which is quite independent of speed." Now is it proved beyond a question that this is the great force which is to be resisted? [It is, beyond all question.—ED.] May not this tendency instead of being a final, independent cause, be a result, in a measure, of centrifugal force? Is not the effect of centrifugal force upon a truck acting through its center of gravity likely to be that of making the leading outer wheel impinge more closely than any other against the rail? Doubtless it is by the outer rail meeting the outer leading wheel that the truck is guided round the curve, but that does not seem to me to prove that that is the greatest force acting.

You say that the tendency to derailment is not much affected by speed. If so why does Mr. WELLINGTON, after a long discussion of curve resistance, say in his general conclusions that "the best rule for superelevation is to elevate for the fastest regular speed up to a maximum of 6 to 8 ins.," which would be as much as required on a large proportion of the curves used, and why in another place that "the proper rule for superelevation is to elevate sufficiently to balance the centrifugal force of the fastest trains up to the above maximum?"

I should like to have you discuss this question at length, for, if your theory is correct, the various engineers' pocket-books and works on track leave the subject very inadequately treated. HENCK has not even dropped from his work the "old hoax" of coning wheels. Yours truly, J. V. HAZEN.

[The treatment of this subject in all the pocket books, from Henck down, is exceedingly imperfect. There is perhaps no subject on which there is a greater amount of misinformation extant, but we do not know how we could add anything to the force or fulness of the data given on this subject on pages 291 to 301 of the work to which our correspondent refers. The general fact is that the flange of the front outer wheel on a curve has to cause three of the wheels to continuously slide on the surface of the rails around the fourth wheel as a center. With a coefficient of friction of 0.25, calling the load on one wheel W, this requires a lateral flange pressure of 0.75 W, and it is this enormous pressure which causes the outer rail to flange-cut so badly, *even in yards where there is no high speed.* A moderately high superelevation diminishes this force slightly and hence is desirable, but it does not follow that if this is lacking it makes any material difference. It amounts only to .017 W, per inch of superelevation, so that an 8-in. elevation, *with no counteracting centrifugal force*, introduces a lateral force of .136 W, reducing by so much the flange pressure. As both wheels on the front axle are acted on in this way the comparison stands: 0.75 W and $(0.75 - .136 \times 2) = 0.48$ W for the extreme difference of 8 ins. in superelevation unbalanced by centrifugal force. On a 5° curve a speed of about 47 miles per hour produces an equal centrifugal force, so that in that case, assuming there were *no* superelevation, there would be the dangerous lateral flange pressure of $(0.75 + 0.27 =) 1.02$ W which is reduced by 8 ins. superelevation to .075 W, and proportionately by less. But it will be seen that a slight difference in superelevation is of little moment. ED. ENG. NEWS.]

PERSONAL.

J. M. BARWELL is Engineer and Secretary of the Jasper Land & Improvement Co., Jasper, Ala.

R. D. ROWE has been appointed Chief Engineer of the New Mexico division of the Atchison, Topeka & Santa Fé Railroad, with headquarters at Las Vegas.

RAYMOND DUPUY has been appointed Second Vice-President of the Chicago, St. Paul & Kansas City R. R., with office at St. Paul. J. M. EGAN has been appointed General Manager with office at St. Paul.

JOHN HERRON has been appointed Principal Assistant Engineer of the Montana Central Ry., with headquarters at Helena. He will have general charge of the engineering office. He has been connected with the road since its construction commenced.

JAMES O'CONNER, railroad contractor, of Oswego, N. Y., who has contracts for the Illinois Central R. R., was contracted in marriage to Miss LILLIAN PHINNEY, at Rockford, Ill., on Feb. 1.

E. B. THOMAS, General Manager of the Richmond & Danville R. R., has been elected 2nd Vice-President of the New York, Lake Erie & Western R. R., in charge of the line west of Salamanca, N. Y. He will have his headquarters at Cleveland, O.

Mr. F. W. GERECKE, the Chief Engineer in charge of the Chicago Water-Works, is a German by birth, and graduated from the Brunswick Academy in Germany. He was engineer to coal mines on the Rhine. In 1860 he came to Brooklyn, N. Y., and worked for a time in machine shops there. In 1862 he designed some of the pumping engines for Newburg, and was Water Commissioner of that city 5 years. Later he was chief draughting engineer in the ship building works of J. BIGLER, and designed a number of iron ferry-boats and steamers; also the 2,000 H. P. engines in the Washburn mills at Minneapolis. Mr. GERECKE is 54 years of age.

S. J. COLLINS, Superintendent of the Kansas City division of the Chicago, Milwaukee & St. Paul R. R., has been transferred to the Chicago and Milwaukee division: W. G. COLLINS will retain the superintendency of the Council Bluffs division, and is relieved of the Chicago & Milwaukee: H. R. WILLIAMS is made Superintendent of the Kansas City division. D. L. BUSH is changed from the Jim River division to the Southern Minnesota division, and C. A. GOODNOW takes his place on the Jim River line.

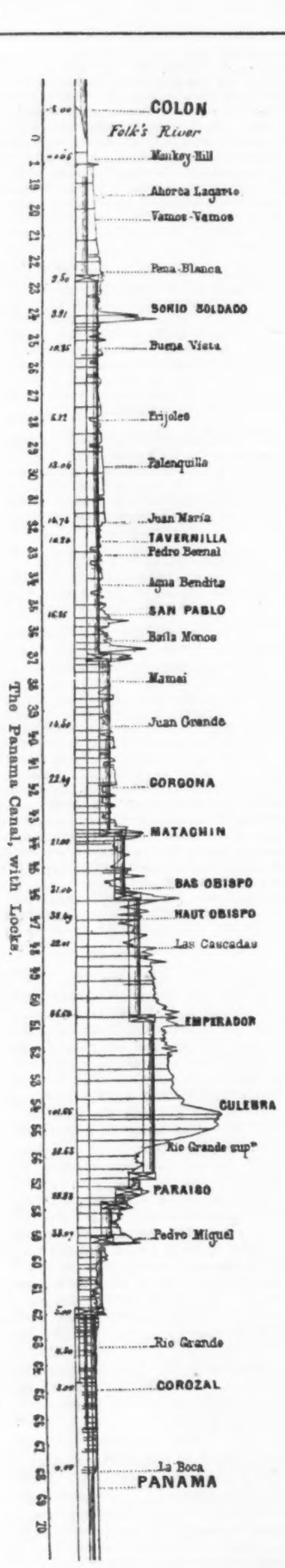
C. P. SANDBERG, of London, well known to American engineers for his able work on improving the quality and form of steel rails, has issued a most excellent pamphlet on the Swedish railway systems, showing by an exceptionally good map the State trunk line, the private lines and short "feeder" lines to both systems.

OSCAR SANNE, designing engineer for the Dominion Bridge Co., has resigned to accept the position of Assistant Engineer in the Bridge and Buildings Department of the Chicago, Milwaukee & St. Paul Ry., at Milwaukee, Wis.

The latest addition to the engineering firms—which we are glad to note the increase of throughout this country—is that of CASE and CROZER of Knoxville, Tenn., who have opened an office in that booming city of the south, as general Civil and Mining Engineers. Both partners have had large experience. WM. N. CASE was engineer from 1873 to 1882, of the Port Henry Iron Ore Co., Witherbee, Sherman & Co.; Crown Point Iron Co.; and Lake Champlain & Moriah R. R. Co.; later on he was Engineer & Supt. of the Mahopac Iron Ore Co. and Mahopac Falls R. R. Co., and in the past year Chief Engineer of the Cumberland Valley & Unaka R. R. Co., now merged in the Nashville & Charleston R. R. Co. W. C. CROZER was engaged in the location and construction of the Cincinnati Southern R. R., and afterward as Asst. on the Tennessee and Cumberland rivers. He has been extensively engaged in mineral exploration through the Southern States. We wish the new firm an abundant success.

A PETITION is now before the Maryland Legislature praying for the revocation of the charter of the Baltimore & Ohio R. R. Relief Association. According to this petition the organization of this relief feature was not an act of pure philanthropy on the part of the railway company. While the company makes no money out of it, it saves a vast sum yearly in avoiding suits for damages and in the care of the sick and the burying of dead employès. The chief point of complaint is that the rates are too high, that the same benefits could be secured from outside insurance companies for one-half the rate paid by the men. According to the rules of this relief association a man receiving over $75 per month pays $48 per year into the relief treasury. For this his wife receives $2000 if he is killed, and $1200 if he dies a natural death, and he gets $2.00 per day for sickness. Employès of less pay than $75 per month are taxed $36 per year with death and sickness benefits in proportion. The point to be made in favor of the association is, that by it the men are compelled to care for themselves and for their wives and children, whereas under other conditions they probably would not. Naturally the expenses of such a limited corporation are greater in proportion than in a general company.

AT the Chicago lake tunnel, the quicksand pocket which lately gave trouble at the shore shaft is in a fair way of being passed. The engineers in charge are now sinking a number of iron pipes on the outside of the iron lining with the purpose of thus furnishing a vent for the quicksand and water, and also relieve the cylinder which is now held by friction in the tough clay. No estimate can yet be made of the extent of the pocket.



The Panama Canal, with Locks.

The Panama Canal with Locks.

The last issue of *Le Genie Civil* contains a general article upon the Panama canal; but the most interesting feature of this exhibit is a description and illustration of the "temporary canal" with locks. We abstract this as follows:

The plan with locks, as approved by the consulting engineers of the Commission, follows the route of the old canal in all essential points, a few slight detours being made to utilize excavation already completed. Starting from the Bay of Limon, on the Atlantic side, the canal preserves the mean sea-level from Colon to Kilo. 22.7 (14.07 miles)* where Mr. EIFFEL proposes to establish his first lock with a lift of 26.24 ft. A second lock with the same lift will be placed at Kilo. 37.2, and then successively two other locks at Kilos. 43.8 and 46.3 with lifts of 36.08 ft. each.

On the Atlantic side four locks will thus bring the canal to the level of +38, or 124.64 ft. above the sea-level. This is the preliminary project, a further study of the means of feeding these levels with water may make considerable change in the final plans.

On the Pacific side the canal will descend by three locks with 36.08 ft. fall each, at Kilos, 57.2, 57.8 and 61.8, and one lock of 26.24 ft. fall at Kilo. 59.1. If too much difficult work is met with and it is necessary to gain time, the company may decide to make another level at an elevation of +49 (as shown on the cut), or 160.72 ft. above sea level. This arrangement would require a fifth lock on each slope, at Kilos. 49.5 and 59.7. "This is one of the advantages of the lock-system in permitting a certain elasticity of plan which does not exist in a sea-level canal."

In each level the normal section adopted for the canal will be maintained. The clear length of the locks will be 180 m. (590.4 ft.) and the width of the gates will be 18 m. (56.04 ft.) At the entrance, on the Colon side, the bed of the canal will be 600 ft. wide for about 1.86 miles of length. On the Panama side this bed will be 164 ft. wide over a length of 3.72 miles. From La Boca, on the Pacific, to Naos the sea channel will be 164 ft. wide.

The full detail of the locks, designed by Mr. EIFFEL, is promised by *Le Genie Civil* in a later issue of that journal. Our contemporary remarks of these locks that the crossing of the isthmus by all other plans, save the Panama sea level scheme alone, necessitates the use of similar locks of a great size, and adapted to the needs of an enormous naval traffic. And now to open the Panama canal at some fixed date a due regard for economy justifies their adoption at that point as well. "The fantastic ship railway so highly extolled by Col. EADS alone escapes this practical necessity." "A canal at sea level is the hoped-for and ultimate end. The canal with locks is the immediate and practical solution; it is the only solution, long foreseen, and is necessary as an intermediate step in the removal of the vast mass of material required to open the final trench."

The proposed working of the canal with locks is described as follows:—It is first assumed that a proper but moderate speed for merchant ships will be 6.2 miles per hour in the long levels of the canal, and 2.23 miles per hour in the short lengths. The time necessary for passing one lock is assumed at about one hour. Then, taking into consideration the time required for a ship to enter the lock and leave it, the filling of the locks and the handling of the gates, etc., a single ship would pass from ocean to ocean in 17 h. 28 m.; a ship with convoy would pass in 28 h. 25 m. On this basis the maritime capacity of the temporary canal would be 10 ships in 24 hours; or, with an average tonnage of 2,000 tons, "25,000 tons daily, or 9,125,000 tons per annum," instead of the 7,500,000 tons assumed as the first year's traffic by the Canal Congress.

The quantity of water necessary for the feeding of the canal, as figured by *Le Genie Civil*, is as follows; For the traffic just given this would be about 40,000 c. m. (1,412,000 cu. ft.) per lock, and 80,000 c. m. (2,824,000 cu. ft.) per ship sent from one ocean to the other. With 10 ships per day this would mean 800,000 c. m. (28,240,000 cu. ft.) daily drawn from the Chagres; or 9.25 c. m. (346.5 cu. ft.) per second. In cluding evaporation and leakage this latter figure can be called 10 c. m., or 353 cu. ft.

*These Kilometers mark the distance from the Atlantic end of the canal. As a kilometer is .62 miles the distance in miles can be easily figured for each lock.

The water shed to be depended upon for this supply is disposed as follows:—(1) The Chagres basin with an area of about 1,125 sq. miles. (2) The basin of the Obispo, with about 113 sq. miles. (3) The basin of the Upper Rio Grande, with about 1.3 sq. miles. At the level of +38 m., or 124.64 ft. above sea level, the canal will be fed from the storage obtained by utilizing the Gamboa dam which will raise the waters of the Chagres to a level of +40 m. But for the upper level of +49 m., if this is found necessary, the natural supply is not so easily obtained. It will be necessary, in some months of the year at least, to pump the water from the +40 level to one of +50; and to do this the total power required will not exceed 3,600 H. P.; or, a power daily developed by the engines of our trans-Atlantic steamers.

CHIEF Engineer WM. H. BROWN, of the Pennsylvania R. R., says in a published letter to the City Engineer of Lancaster, Pa:

"We are just finishing up a contract with the city of Pittsburg that has been about ten years in progress, and we are building a bridge this winter to shut up the last grade crossing that we have in that city. We have no grade crossings in the city of Philadelphia, on the main line of the Pennsylvania railroad, and I cannot think that the city of Lancaster desires to make any grade crossings that can possibly be avoided."

The letter is accompanied by plans showing how, by a remodelling of streets, a great number of grade crossings could be avoided in Lancaster.

CONSTRUCTION NEWS.

Water.

Water Meters.—In consequence of the excessive waste of water at New Bedford, Mass., the mayor has recommended the general use of meters.

Galveston, Tex.—It is suggested that as the highest point on the island is only 7 ft. above mean high tide, which is too little for sewer drainage, and that as the need of sewerage will follow after the new water-works, the island will have to be raised about 10 ft. by filling. Already money has been provided for beginning this work, and City Engineer WILSON has presented a plan for raising Broadway, a fine street from the gulf to the bay, about 10 ft.

Fort Benton, Mont.—It is proposed to obtain a water supply from the Tetonriver, which parallels the Missouri for several miles. The Teton is 17,760 ft. from the Missouri, and is at an elevation of 100 ft. above it. It is proposed to tunnel the hill and obtain a gravity supply of 1,000,000 galls. per day. The cost is estimated at $41,000.

Water-Works Franchises.—At Albany, N. Y., a bill has been introduced by Assemblyman MASE, providing that contracts between corporations and villages for water supply shall not be for more than 30 years, and the aggregate sum involved shall not exceed $5,000,000 of taxable property, and covering cases where only parts of towns are supplied with water by private corporations.

The Albany Water-Works.—The controversy long pending in Albany over the plans of Mr. JOHN H. MARR, engineer to the old water commission, and Mr. I. M. de VARONA, engineer for the special water commission, was referred to Mr. A. FTELEY, consulting engineer of the New Croton Aqueduct for final decision. Mr. FTELEY after a thorough examination of the ground and plans, decides in favor of Mr. de VARONA's plans for the following reasons:

First—That there will result thereby a very large economy in the cost of construction and maintenance.

Second—That the proposed location at the Flats is preferable to that at Quackenbush, where the room secured is insufficient.

Third—That the plan advocated is superior to the other in simplicity of design and directness.

Fourth—That there will be much less liability to accidents, as in case of fire, which Mr. FTELEY states might cripple the station at Quackenbush to the extent even of interrupting the city supply; so that, in his opinion this consideration alone would be sufficient to prefer the location at the Flats.

Mr. FTELEY's decision has been accepted by the old board of water commissioners, and both commissions are now working harmoniously.

The Value of Water Meters.—This is shown by the report of the Water Board of Fall River, Mass., for 1887. The total amount of water pumped in 1887 was 4,600,000 galls. less than in 1886, a saving in pumping which is attributed to the waste prevented by the use of meters. We quote from the Water Register's Report, as follows: "Although the appropriation from the city was reduced $6,000 this year, the total revenue is more

than that of 1886 by over $1,600. The receipts from meters are $72,247.07, giving an increased revenue from this source of something over $8,300 as compared with the meter payments of 1886. The proportion of meter receipts to the amount obtained from both classes of consumers is the large one of 87 per cent. The meters therefore give the increased revenue, as shown by the above figures, and the falling off in the receipts from takers paying schedule rates, many of whom change every year to payment by meter rates." In his report the Superintendent says, that "Meters are in as great demand as ever." The number of meters now in use is 2,941. During the past year there were added for new water takers 224 new meters, all of these were *Crown meters*.

The Bassett Circulating Hydrant Branch.—Bassett Bros., engineers and contractors, of Buffalo, N. Y., are introducing a circulating hydrant branch by which dead ends can be avoided. On the main pipe is placed a special casting with sockets for two branch pipes which run to a Y casting, the stem of which is attached to the foot of the hydrant; hydrants can be furnished with openings for 2 pipes if desired. The flow of water in the main pipe causes a current and a constant circulation in the branches; by this means water cannot become stagnant and foul at dead ends, nor can the water in the branch pipes freeze. An important point is that the circulating water keeps the whole lower part of the hydrant warm and prevents water in the bottom of the hydrant from freezing. The original idea was to keep the branch and hydrant free from ice, but much more than this has been accomplished. The firm has set 156 hydrants with the improved branch in three different water-works; during the late cold weather they were carefully observed but never have frozen, although some of them are in exposed places.

Water-Works.—***Maine.***—Portland. There is considerable complaint over the insufficiency of the supply and it is claimed that the water company has not complied with the requirements of its contract, a reservoir of 16,000,000 galls. capacity and a stand-pipe called for in the contract not having been constructed.

New Hampshire.—Milford. At the first meeting of the Milford Water-Works Co., held recently, C. S. AVERILL was elected chairman and N. W. ELLIS, of Manchester, clerk. The capital stock was fixed at $40,000. A proposition from a Manchester syndicate to take the charter, furnish capital and build and operate the works, was discussed and will be considered at the annual town meeting, March 13.

Massachusetts.—Randolph. The Water Commissioners will apply to the Legislature for authority to issue $20,000 for extensions, etc.; this amount being in addition to the $100,000 bonds already issued.

New York.—Buffalo. The Water Commissioners will recommend the following improvements: a new storage and distributing reservoir on the Dodge farm, a 20,000,000 galls. pumping engine in addition to the one now being built by the Holly Co., and 2 lines of mains 36 and 42 ins. diameter. The capacity of the old reservoir is 12,000,000 galls. and the present daily capacity of the 4 pumping engines is 55,000,000 galls.——Cuba. It is probable that a system of water-works will be built, at a cost of about $50,000. The water will be pumped to a reservoir.——Jamaica. The application of the Woodhaven Water Co. (F. GROSJEAN) for power to furnish water has been granted, except for the village, which is supplied by the Jamaica Water Supply Co.——Lansingburg. A bill has been presented to authorize the Water Commissioners to issue $25,000 additional bonds for water supply.——Waterville. Thirty of the $1,000 water-works bonds have been delivered to Daniel A. Moran of New York, who contracted to purchase the entire $50,000 at 2½ % premium, for which the village has received $30,750. The balance will be issued at an early date. Work is progressing on the reservoir and pipe line.

New Jersey.—Jersey City. At the meeting of the Board of Public Works on Feb. 1 a resolution was passed directing the Clerk to advertise for proposals for furnishing a supply of pure water. The water to be delivered in the high service reservoirs, and the contractor to keep in repair the pumps, reservoirs and mains at Belleville and the Hackensack meadows. The contract to be for 10 years. Chief Engineer RUGGLES has prepared specifications.

Maryland.—Baltimore. A reservoir at Towsontown is projected to be built by the city; water would be pumped from Loch Raven by the engines formerly used for the temporary supply and neighboring villages could be supplied.——Waverly. The Waverly Water Co. is to be organized.

Pennsylvania.—Meyersdale. The Meyersdale Water Co. has been organized by WM. POLLOCK and others with a capital stock of $5,000.

Ohio.—Fostoria. Ferris & Halladay, of Jersey City, N. J., have asked for a new franchise on more liberal terms as the works will cost more than was anticipated. The new terms will be $75 each for 100 hydrants.——Washington C. H. The proposition is to put in 14 miles of pipe, 125 hydrants and pumping plant of 3,000,000 galls. capacity; the city to pay an annual rental of $5,000 for 20 years.

West Virginia.—Wheeling. Additional pumping machinery is to be put in for direct pumping.

Tennessee.—Bristol. The Water Committee recommends the issue of $50,000 in bonds to build the new water-works.——Memphis. The Artesian Water Co., which began operations 6 months ago, with a capital of $100,000, has purchased the plant of the old water company, which supplied the city from Wolf creek, for $555,000. The company will issue $750,000 stock and $500,000 bonds; $700,000 will be spent at once in improvements. There are 35 miles of pipe and the company will add 15 miles, put down 20 wells, build a stand-pipe and establish 2 pumping engines with a daily capacity of 10,000,000 galls.

Kentucky.—Paducah. A water company is to be organized.——Paris. Water-works are to be built.——Ashland. Col. Forbes has made an offer to build the proposed water-works.——Covington. The City Council has approved the issue of bonds for $400,000 for completing the new water-works.

Florida.—Osceola. Water-works are to be built.——Orlando. The water company will extend its pipes.

Louisiana.—Baton Rouge. Smedley & Wood, of Dubuque, Ia., who have the contract to build the water-works, have arrived in the city and will commence work at once.

Indiana.—Loogootee. A water supply is being established. The water is pumped to a tank by a wind engine, and distributed through pipes.——Cambridge. Water-works are contemplated.

Michigan.—Lapeer. Water-works are to be established, and proposals for $40,000 in bonds will be received by J. B. MOORE, President of Water Commissioners, until March 1.

Illinois.—East St. Louis. The water company has received a new pumping engine, with a daily capacity of 4,000,000 galls., from the Deane Steam Pump Co., Holyoke, Mass.

Missouri.—St. Louis. Surveys have been started for the conduit from Chain of Rocks to Grand avenue, for the new water supply. The new works will cost $3,000,000 and will occupy 4 years in building. They will have a daily capacity of 100,000,000 galls.

Arkansas.—Rogers. A water company will be organized with a capital stock of $10,000. There will be 4-in. pipe and a pump with a daily capacity of 30,000 to 50,000 galls.

Kansas.—Springfield, The Springfield Light, Heat & Water-Works Co. has been incorporated by E. A. WATSON, THEO. PIERCE, E. M. CAMPBELL, and others. Capital stock, $30,000.——Ness City. The Ness City Water-Works Co. has been incorporated by O. H. LARAWAY, J. G. IBACH, C. M. VANPELT, and others. Capital stock, $100,000. The city has voted $25,000 bonds for water-works.——Coolidge. A water supply is to be established; the water will be drawn from artesian wells and pumped to a stand-pipe.

Colorado.—Salida. The Salida Artesian Well & Improvement Co. has been organized by J. W. WOOD, Dr. A. J. OVERHOLT and others. Capital stock, $20,000. A well will be started at once.

Montana.—Anaconda. Water-works are to be established by a local company.

California.—Santa Barbara. W. R. COATS, of Kalamazoo, Mich., is preparing plans for a water supply.

Texas.—Rockdale. Water-works are projected, and as the need of a supply is much felt, active steps will probably be taken without delay.

Canada.—Hamilton, Ont. The new pumps built by the Osborne Kelley Co. were tested recently. The engines, boilers, etc., will cost $72,000.

The Water at Ottawa, Canada.—Dr. A. T. ROGERS does not think the Ottawa river water was the cause of the recent typhoid epidemic. In answer to the statement that there is an excessive amount of vegetable matter in the water, he says that vegetable decomposition does not cause typhoid fever, but that sewage will cause typhoid, while the analyses show that there is no sewage contamination. He attributes the epidemic to bad drainage and defective sanitation and urges that, before expense is incurred for the water supply, a committee of physicians be appointed to investigate the cause of the epidemic.

Water Waste at Brooklyn, N. Y.—The consumption is reaching enormous figures. The daily minimum supply is about 49,000,000 galls., but recently the consumption has far exceeded that amount. On January 27, the consumption was 61,223,330 galls., and on January 28 it was 61,028,556 galls. Once more the urgent necessity of the extension of the supply system is to be placed before the aldermen for action.

Pittsfield, Ill.—The material for the tank is delivered but has not yet been erected owing to the extreme cold weather. In a few weeks work will be commenced on an artesian well, 2,000 ft. deep. The proposals for the tower, which were opened in September, 1887, were all considered too high, and the work was undertaken by the city; the lowest bid was from G. C. Morgan, of Chicago, $6,600, and the commissioners had the work done for a less amount. The tower is of brick, 15 ft. 10 ins. external diameter at the base, and 15 ft. at the top; it is 85 ft. high and the wall is 34 ins. thick at the base and 27 ins. at top. The contract for the tank was let to Wm. Drake, of Springfield, Ill., for $1,860 complete; it is 15 ft. external diameter and 38 ft. high. Pipe and hydrants have been delivered. The contract for drilling the well has been awarded to Laney & Churchill, of Indianapolis, Ind.; it will be 8 ins. diameter to 400 ft. deep and 5½ ins. for the rest of the distance. SCOTT WIKE is Water Commissioner.

Artesian Wells.—***Ottumwa, Ia.***—The Ottumwa Development Co. struck a flow of fresh water Jan. 26 at a depth of 1,460 ft., equal to 2,500 galls. per hour, in addition to the former flow of 1,100 to 1,200 galls. The company is prospecting for natural gas and will put the well down 2,000 or 2,500 ft. if necessary.

Houston, Tex.—The water company proposes to put down 10 artesian wells, 6 ins. diameter, to secure an additional water supply. A test well struck water at 140 ft.

Pueblo, Col.—A number of people are putting down artesian wells for private water supply.

Devil's Lake, Dak.—An artesian well is to be put down for a water supply. Address H. C. HANBROUGH, Mayor.

Electric Light & Gas.—***Zanesville, O.***—The Zanesville Electric Light Co. has increased its capital stock from $25,000 to $75,000.

Helena, Ark.—The Helena Electric Light & Power Co. opened its books Jan. 18, and the $25,000 capital stock was quickly subscribed. A site will be selected and work commenced shortly; the lights are to be ready for use within 60 days. President, JAS. SUMMERS; Vice-President, LEON BERTON; Secretary, JACOB TRIEBER.

Fayetteville, Ark.—The Fayetteville Electric Light & Power Co. has been organized with a capital stock of $36,000. The Heisler incandescent system will be adopted.

Tyler, Tex.—The City Council has entered into a contract with an electric light company for furnishing the city with electric light for 10 years.

Tallahassee, Fla.—The Tallahassee Gas & Electric Light Co. has been organized with a capital stock of $50,000, and will build gas works at once. President, E. S. CRILL; Secretary, W. M. MCINTOSH, Jr.

Lima, O.—The City Council has awarded the contract for lighting the streets and public buildings for 1 year, to the Lima Electric Light & Power Co., at $58 per light.

Tonawanda, N. Y.—The Tonawanda Electric Light Co. has been incorporated by C. SCHWINGER, A. G. KENT and others, to furnish electric light and gas in Tonawanda and Wheatfield.

Sewerage.—***Brockton, Mass.***—The Council has passed an order authorizing a petition for an act to permit the city to construct a drainage system.

Kansas City, Kan.—The city has accepted a proposition made by a firm of civil and sanitary engineers, of Kansas City, Mo., to establish a complete system of sewerage and street grades. The work to occupy 6 months, and the city to pay $250 per month.

Helena, Mont.—The city will issue bonds for $120,000 for a system of sewerage. Surveys and plans will be started shortly and work commenced in the spring.

Sherman, Tex.—A proposition to put in a sewerage system, at an estimated cost of $60,000, has been made by URBAN BROUGHTON, of Chicago.

New Rochelle, N. Y.—The Citizens' Committee has approved plans for a sewerage system, and will apply to the Legislature for power to carry out the work.

Fresno, Cal.—An engineer has been engaged to prepare plans for a sewerage system.

Holly Manufacturing Co.—A Remarkable Growth.—The average of all the contracts for engines which the company has in hand is nearly 5,000,000 each. In 1886 contracts were made for 43 pumping engines, having a total capacity of 126,000,000 galls. daily. In 1887 contracts were made for 40 engines, having a total capacity of 147,850,000 galls. daily. *From this it will be seen that the sizes of the machines are gradually increasing.* At the time of the publication of the pamphlet in 1886 the list showed that 190 pumping engines had been sold. In preparing matter for a new pamphlet it is found that the total number of pumping engines sold up to Feb. 1, 1888, is 282, an increase of 92 in about 2 years.

Winnipeg (Man.) Water-Works.—The Winnipeg Water-Works Co. is advertising in London England, the issue of the unsubscribed remainder of 300 6% first mortgage debentures of $500 each, being the balance of 1,000 debentures, the total amount to be created, of which 700 have already been issued. The city has a population of about 25,000. The works, constructed in 1882-83 for a population of about 10,000, having become quite inadequate for the requirements, the company in 1886 created $500,000 first mortgage debentures, of which $350,000 were issued in that year. From the proceeds all previous bonds and liabilities were liquidated and

funds provided for adding 7 miles of mains to the 7 miles already laid. The whole of the pipe for the extension has been delivered, part is being laid, and the work is expected to be in operation in a few months.

In the meantime it has became evident that these extensions are still not adequate to the needs of the city. The City Engineer has reported to the city authorities that there are 22 miles of mains, in addition to the 7 in operation, that would return a rental equal to 10 per cent. upon the cost of laying. The Directors are of opinion, from the experience of the last 12 months under the present management, and from the applications made to them for the extension of mains, that the system should be extended as soon as possible up to 20 miles, and subsequently to 25 miles of mains. They have also determined to erect improved filtering apparatus to meet the only objection to the company's supply, viz., that after freshets, the river water deposits a certain quantity of silt. They have satisfied themselves by experiment that this can be entirely removed by suitable filtration, which will result in a greatly increased consumption for domestic purposes. Of the 7 miles of old mains in operation, 5½ miles, notwithstanding recent considerable reductions in rates, already earn $3,000 per mile per annum, and new consumers are coming in at the rate of about $400 per mile per annum, a rate of increase which will become much greater when the new filters are at work. The City Engineer has estimated that 20 miles of mains would earn, if the works were in possession of the city, $59,750 per annum, and that the central portions would earn $6,000 per mile. The company can obtain considerably higher rates than the Corporation would charge, but at even this low estimate, and allowing $15,000 per annum for working expenses (at present about $10,000), 20 miles would earn a net revenue of $44,750, sufficient not only to pay interest and sinking fund upon the whole debenture debt of $500,000, but also to leave a surplus.

The company's engineers estimate the net revenue from 20 miles of mains at the company's rate of charge at $55,000, and that the system can be extended to this point at a further cost of $75 000, or about half the proceeds of the present issue, leaving the remainder as a reserve for future works and other purposes. The president of the company is ALEX. MOFFATT, of Winnipeg; the engineers are WELLS OWEN and ELWES, of London, England.

Reading, Pa.—Dr. ALBERT R. LEEDS, of the Institute of Technology, Hoboken, N. J., who was employed by the Water Board to analyze samples from the various possible sources of supply, has forwarded his report and decides in favor of the water of the Maiden creek as being in all respects the best suited for domestic use. He suggests, however, that the water, which is largely impregnated with limestone, be filtered and softened. The flow of the Maiden creek at its lowest stage is about 20,000,000 galls. daily, while at most seasons of the year it is from 30,000,000 to 40,000,000 galls.

The Water Commissioners have decided to tap this water at a point 7 miles above the city and pump it to the storage reservoirs. The creek is a large stream rising in Lehigh county and flowing about 20 miles through a limestone region to the Schuylkill. The work cannot be undertaken until the question of increasing the indebtedness of the city is passed upon at the spring election; if the vote is favorable, work will be commenced at once. The estimated cost is $300 000.

Proposals Open.

Water-Works.—Bonds for $5,000 to be issued. E. S. REID, Chatham, Va.

City Hall.—S. HANNAFORD & SONS, architects. R. ALLISON, Chairman, City Hall Trustees, Cincinnati, O. Feb. 13.

Electrical Supplies.—For 2,500 3-lb. circular zincs (best Lehigh spelter), 1,000 3 sheet battery coppers, Bishops' insulated wire, 40 barrels of "bluestone." J. ALEX. PRESTON, President, Fire Commissioners, Baltimore, Md. Feb. 14.

Water-Works.—Direct pressure system for fire protection. Pump house, pump and all appurtenances, mains, specials, hydrants, gate valves, hose, hose carts, etc. W. B. GARRETT, Chairman of Fire Committee, Murfreesboro, Tenn. Feb. 15.

Paving Blocks and Curbstones.—Granite paving blocks, 60,000, and granite curbstones. THE PARK COMMISSIONERS, 87 Milk street, Boston, Mass. Feb. 17.

Lumber.—White oak timber for lock gates at St. Mary's Falls canal. Lt. Col. O. M. POE, U. S. Engineers Office, Detroit, Mich., Feb. 18.

Swing Bridge.—Wood or iron: across the Narrows, near Orrillia. Plans and specifications on file. J. B. THOMPSON, Bridge Commissioner, Orrillia, Ont., Canada. Feb. 18.

School.—On 138th and 139th streets. THE SCHOOL TRUSTEES FOR 23RD WARD, 146 Grand street, New York City. Feb. 20.

Federal Building.—At Brooklyn, N. Y. THE SUPERVISING ARCHITECT, Treasury Department, Washington, D. C. Feb. 21.

Street Work.—Regulating, grading, paving, curbing and flagging. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. Feb. 21.

City Hall and Market House.—ALFRED MULLER, architect. THE COMMITTEE ON PUBLIC PROPERTY, Galveston, Tex. Feb. 22.

Bridge.—Substructure and iron superstructure, over the Ottawa river. M. J. COONEY, County Auditor, Toledo, O. Feb. 28.

Submerged Pipe.—Dredging and laying about 6,000 ft. of 18-in. and 4,000 ft. of 8-in. pipe, at Marinette, Wis. AMERICAN WATER-WORKS & GUARANTEE CO., Pittsburg, Pa. Feb. 28.

Supplies.—Copper tubing, wire rope, oils, charcoal, nuts and wrenches, packing and yellow pine. JAMES FULTON, Paymaster General, U. S. N., Navy Department, Washington, D. C. Feb. 29.

Sewers.—Estimated cost, $30,000. W. A. WAGNER, City Clerk, Beatrice, Neb. March 1.

Paving.—Medina sandstone paving. WALTER P. RICE, City Engineer, Cleveland, O. March 1.

Stone.—For a lock in the Kentucky river at Beattyville, Ky.: about 4,601 cu. yds. Amount available, about 8[illegible],000. Major AMOS STICKNEY, U. S. Engineer Office, Louisville, Ky. March 3.

Court House.—At Liberty, Ky. MCDONALD BROS., Architects, Louisville, Ky. March 5.

Contracting.

Street Railroad.—Haines Bros., of New York, will build a dummy line at Macon, Ga., for the Macon City & Surburban Railway, Light & Power Co.

Granite.—The Hurricane Granite Co., of Rockland, Me., has finished its contract on the court house at Boston. The remainder of the building will cost $305,500 of which the Hurricane Granite Co. has $161,500 and the Cape Ann Granite Co., $144,000.

Depot.—Gibson Bros., of Columbus, O., have the contract for a depot at Logansport, Ind., for the Pennsylvania Co., to cost $25,000.

The Bowers Dredging Co. has been incorporated at Chicago, Ill., with a capital stock of $200,000, by A. L AMBERG, L. W. BATES and H. A. CHISTY.

Supplies.—At Louisville, Ky., contracts have been awarded as follows: Sand, Pat Donahue, 85 cts. per load: J. H. Egelhoff, 90 cts. Lime and cement, Utica Lime Co., 95 cts. and $1.25 per bbl. Brick, J. H. Egelhoff, $7.50 per 1,000 for sidewalk work, $6.75 for sewers and cisterns; M. Berger, $8 and $7.50. Stone and pipe, N. W. Walker Clay Mfg. Co. Hardware, Geo. B. Bahr & Co.

Cement.—The following proposals were received by the Docks Commissioners, New York City: Marcial & Co., $2,33 per barrel; E. W. Fisher, $2.50; A. C. Babson, $2.55; J. L. Merchant & Co., $2.90. The contract was awarded to Marcial & Co.

Pumping Engines.—The following proposals have been received by GEO. B. SWIFT, Commissioner of Public Works, Chicago, Ill., for 2 engines, with a daily capacity of 10,000,000 galls. each, including boilers, etc.: Quintard Iron Works, New York City, 2 triple expansion beam engines with 16, 25½ and 44-in. cylinders; vertical single acting, plunger pumps 21½ ins. diameter; stroke 8 ft.: $185,000. Holly Manufacturing Co., Lockport, N.Y., 2 No. 7 Gaskill engines, with 6 boilers, $83,500; or 2 No. 8 Gaskill engines, $98,500; or 2 vertical pumps, $93,500. Wm. Wright & Co., Newburg, N. Y., 2 triple expansion engines with 6 boilers, $113,993. Henry R. Worthington, New York City, $92,055, $94,555, $107,055.

Water-Works.—*Holdrege, Neb.*—The franchise for water-works has been awarded to Ben. S. Clark, of Ashland, Neb. He will receive $65 per year for hydrants. A. A. RICHARDSON, of Lincoln, Neb., is Consulting Engineer.

South Evanston, Ill.—Geo. C. Morgan, of Chicago has the contract for water-works, to cost $20,000.

Hillsboro, Ill.—The Beloit Wind Engine Co., of Beloit, Wis., has been awarded the contract for the water-works. They will cost about $20,000. Work will be begun early in April.

Greensboro, N. C.—The contract for the water-works has been awarded to Chas. Hindman, of Philadelphia, W. Taylor, of Philadelphia, and Frederick Hubbell, of Baltimore.

Jersey City Streets.—In view of the bad and neglected condition of the streets of Jersey City, N. J., a movement is under way to secure the passage of a bill by the Legislature authorizing the issue of $300,000 of bonds for street improvements. The bill, it is said, will provide that the expenditure of the money and the improvements contemplated shall be under the supervision of the Board of Finance.

Viaduct.—The following proposals for building and erecting an iron viaduct about 900 ft. long, on the line of 4th street, Kansas City, Mo., were received Jan. 28, by JOHN DONNELLY, City Engineer: Wrought Iron Bridge Co., Canton, O., $22,500; Columbia Bridge Co., Dayton O., $25,192: Penn Bridge Co., Beaver Falls, Pa., $25,200; King Iron Bridge & Manufacturing Co., Cleveland, O., $25,646; Milwaukee Bridge & Iron Works, Milwaukee, Wis., $26,400; Atlanta Bridge & Axle Co., Atlanta, Ga., $26,500; P. E. Lane, Chicago, $26,666; Pittsburg Bridge Co., Pittsburg, Pa., $27,575; A. J. Tullock & Co., Leavenworth, Kan., $27,900; Kansas City Bridge & Iron Co., $27,984; Keystone Bridge Co., Pittsburg, Pa., $34,900. The contract was awarded to the Wrought Iron Bridge Co., Canton, O.

PROPOSALS.

AQUEDUCT COMMISSIONERS' OFFICE,
Room 209, Stewart Building, No 280 Broad'y
NEW YORK, Feb. 8th, 1888.

[Number 1.]

To Contractors.

BIDS OR PROPOSALS FOR FURNISHING and delivering and laying 48 inch cast-iron pipes and their appurtenances, from 135th street and Convent avenue to the proposed Gate House in the Central Park Reservoir, and doing all other work in connection therewith necessary to complete Section 16 of the New Croton Aqueduct, as called for in the approved forms of contract and specifications on file in the office of the Aqueduct Commissioners, will be received at this office until Wednesday, the 29th day of February, 1888, at 3 o'clock P. M., at which place and hour they will be publicly opened by the Aqueduct Commissioners and the award of the contract for doing said work and, furnishing said materials will be made by said Commissioners as soon thereafter as practicable.

Blank forms of said approved contract and the specifications thereof, and bids or proposals, and proper envelopes for their inclosure, and form of bonds, and also the plans for said work, and all other information, can be obtained at the above office of the Aqueduct Commissioners on application to the secretary.

By order of the Aqueduct Commissioners.

JAMES C. SPENCER,
President.

JOHN C. SHEEHAN,
Secretary.

6-3t

AQUEDUCT COMMISSIONERS' OFFICE,
Room 209, Stewart Building, No. 280 Broad'y.
NEW YORK, February 8th, 1888.

[Number 2.]

To Contractors.

BIDS OR PROPOSALS FOR FURNISHING and delivering cast iron pipes and special pipe castings, to be used on section 16 and section 17 of the new aqueduct, at such places in the city of New York as may be designated by the Aqueduct Commissioners and as provided for in the approved form of contract and specifications now on file in the office of the Aqueduct Commissioners, will be received at this office until Wednesday, the 29th day of February, 1888, at 3 o'clock P. M., at which place and hour they will be publicly opened by the Aqueduct Commissioners, and the award of the contract for doing said work and furnishing said materials will be made by said Commissioners as soon thereafter as practicable.

Blank forms of said approved contract and the specifications thereof, and bids or proposals, and proper envelopes for their inclosure, and form of bonds, and also the plans for said work, and all other information, can be obtained at the above office of the Aqueduct Commissioners on application to the Secretary.

By order of the Aqueduct Commissioners.

JAMES C. SPENCER,
President.

JOHN C. SHEEHAN,
Secretary.

6-3t

AQUEDUCT COMMISSIONERS OFFICE,
Room 209, Stewart Building, No. 280 B'way,
NEW YORK, February 8th, 1888.

[Number 3].

To Contractors.

BIDS OR PROPOSALS FOR HANDLING and hauling and laying 48-inch cast-iron pipes and their appurtenances from 135th street and Convent avenue, to the proposed Gate House in the Central Park Reservoir, and for doing all other work in connection therewith necessary to complete Section 16 of the New Croton Aqueduct, as called for in the approved forms of contracts and specifications, on file in the office of the Aqueduct Commissioners, will be received at this office, until Wednesday, the 29th day of February, 1888, 3 o'clock p. m., at which place and hour they will be publicly opened by the Aqueduct Commissioners, and the award of the contract for doing said work and furnishing said materials will be made by said Commissioners as soon thereafter as practicable.

Blank forms of said approved contract and the specifications thereof, and bids or proposals, and proper envelopes for their inclosure, and forms of bonds, and also the plans for said work, and all other information, can be obtained at the above office of the Aqueduct Commissioners on application to the secretary.

By order of the Aqueduct Commissioners.

JAMES C. SPENCER,
President.

JOHN C. SHEEHAN,
Secretary.

6-3t

Pier.—The following proposals have been received by the Docks Commissioners, New York City, for removing the existing pier at W. 38th street, North river, and building a new pier and approach complete: Richard Cronin; repairs to bulkhead, etc., $1,120; pier and approach complete, $45,280; total, $46,400; John Gillies, $1,300, $45,200, $46,500; O'Connell & Coffey, $1,575, $45,790, $47,365; J. H. Staats, $1,075, $48,410, $49,485; P. Sanford Ross, $1,275, $48,700, $49,975; Wm. P. Kelly, $1,224, $53,000, $54,224; James G. Hasting, $900, $55,000, $55,900; John W. Flaherty, $1,375, $54,700, $56,075. The contract was awarded to Richard Cronin.

Curtis & Curtis, successors to Forbes & Curtis, of Bridgeport, Conn., manufacturers of the Forbes patent die-stock, pipe threading and cutting-off machines, etc., report business still very good. While running all the men that the works will accommodate, they are still behind their orders for pipe machines. They have just filled orders for large pipe machines for the Pennsylvania R. R. Co., the Central Forge Co., of Whitestone, N. Y., the Cumberland Mills, of Maine, and others. During January their shipments were nearly double what they were in January, 1887, and they are looking forward to the spring trade with great expectations.

Machine Tools.—The following proposals for eleven 6-in. lathes and one slotter, for the Washington Navy Yard, were opened by the Secretary of the Navy, at Washington, D. C., Feb. 2: Group No. 4; 1 lathe for 6-in. B. L. R.: Albert Flagler, New York City, $10,650; Bement, Miles & Co., Philadelphia, $19,950; Niles Tool Works, Hamilton, O., $20,850. Group No. 5; 5 lathes for 6-in. B. L. R. hoops: Detrick & Harvey, Baltimore, Md., $15,342; Albert Flagler, New York City, $19,750; Israel H. Johnson, Jr. & Co., Philadelphia, $23,298; Fitchburg Machine Works, Fitchburg, Mass., $23,915; Pond Machine Tool Co., Plainfield, N. J., $51,000, $62,500; Niles Tool Works, Hamilton, O., $53,750 (crank slotter), $63,000 (geared slotter); Bement, Miles & Co., Philadelphia Pa., $56 250, $64,350. For 10 lathes, Detrick & Harvey, Baltimore, Md., $30,081; Albert Flagler, New York City, $39,500; I. H. Johnson, Jr., & Co., Philadelphia, $43,285; Fitchburg Machine Works, Fitchburg, Mass., $47,830. Group No. 6; 1 slotter for 12-in. B. L. R. trunnion bands: S. C. Forsaith Machine Co., Manchester, N. H., $5,016.98; Niles Tool Works, Hamilton, O., $7,500; Bement, Miles & Co., Philadelphia, $7,950.—Proposals for sixteen 16-in. gun lathes will be received until March 1.

Water-Works for Cedar Falls, Ia.—The following proposals were opened by the Water-Works Committee, Jan. 31: Works complete: American Water & Gas Works Construction Co., Chicago, $16,800, pump 18½ x 10½ x 10, Ludlow valves; Dennis & Connel, Muscatine, Ia., $18,400; W. T. Casgrain & Co., Milwaukee, Wis., $19,357; Eclipse Wind Engine Co., Beloit, Wis., $20,560; Sturtevant & Carr, Minneapolis, $23,617. Deane pump 18 x 10½ x 10.—Pipe and specials: Shickle, Harrison & Howard Iron Co., St. Louis, $30.40 per ton, 3 cts. per lb.; Dennis Long & Co., Louisville, Ky., $32.75 for 4-in., $31.75 for 6 and 8-in., 3½ cts.; Rugg, Fuller & Co., Minneapolis, $32, 3¼ cts.; Conners, Cedar Rapids, $38, 3¼ cts.; Addyston Pipe & Steel Works, Addyston, O., $31.50, $32.50, specials, $60 per ton; Hodman Bros., St. Paul, $30,65, specials, $60; Detroit Pipe & Foundry Co., Detroit, Mich., $30,80, specials, $46.50.—Hydrants and valves: R. D. Wood & Co., Philadelphia; W. T. Casgrain & Co., Milwaukee; D. Kennedy, New York; Hodman Bros., St. Paul; National Tube Works Co., Chicago, (Ludlow valves); Conners, Cedar Rapids.—Pumps, etc.: Gordon & Maxwell, Hamilton, O., engine, $2,650, $3,060; boiler, $1,010; Pond Engineering Co., St. Louis, Mo., pump, $3,220, heater, $160; Deane Pump Co., Holyoke, Mass., pump, $3,350; Robinson, Cedar Falls, pump house, $1,750; Weisbard, Cedar Falls, pump house, $1,333.52; Conners, Cedar Rapids, pump house, well and gallery, $3,257.

The contract was awarded to the American Water & Gas Works Construction Co. The work includes 12,100 ft. of 4, 6 and 8-in. cast-iron pipe and specials, 25 fire hydrants, valves; one 100,000 galls. pumping engine with boiler; engine house, stack, pump well and filter gallery. LOWETH & CURTIS, St. Paul, Minn., are the consulting engineers.

RAILROADS

East of Chicago.

Existing Roads

South Pennsylvania.—The announcement is again made that the affairs of this company have been put on a sound basis and that work will begin immediately so that the line may be completed and opened for traffic as soon as possible. Further particulars are given on our Engineering News page.

Quebec Central.—During 1887 the Dominion Lime Company built a 5 mile line from Dudswell Jct. toward Arthabaska, which was leased to this company.

Buctouche & Moncton.—This New Brunswick line has been sold to a syndicate, represented by Dr. LOUIS J. DE BERTRAM of Brooklyn, N. Y. The new management will extend the line this season to Kingston and Richibucto.

Baltimore & Ohio.—This company's common stock was sold below par in Baltimore on Feb. 8, for the first time in many years. Three small lots were sold at 95, and it is feared that if a large amount of stock is put on the market the price may go considerably lower.—An attempt is to be made to annul the charter of the Baltimore & Ohio Relief Association. The Knights of Labor have petitioned the Maryland Legislature to that effect, claiming that the compulsory insurance is prejudicial to the employés.—The line from Glenwood to Wheeling, W. Va., is to be double tracked.

Ohio & Mississippi.—This company's trains are now running into Louisville, Ky., over the Kentucky & Indiana Bridge Company's tracks.

Maine Central.—The directors have voted to build 8 iron bridges between Portland and Vanceboro. About 400 flat and box cars are to be built at the Waterville shops. Negotiations are in progress for a lease of the Portland & Ogdensburgh.

Rockland Limerock.—This short road at Rockland Me., will be built as soon as frost is out of the ground. Cars and ties have been purchased and the company is now negotiating for locomotives.

Dayton, Fort Wayne & Chicago.—It is stated that the prospects are good that the company will not be placed in a receiver's hands. An adjustment of affairs with the creditors of the company is being negotiated and is likely to succeed.

Lake Shore & Michigan Southern.—Press reports state that unless the company completes the old Chicago & Canada Southern line, the charter for which expires this year, several companies will at once apply for a charter to occupy the same ground, among them being the Atchison, Topeka & Santa Fé, which desires a line to Detroit.

Grand Trunk.—The consolidation of the Northern & Northwestern railways with this system has been ratified. This adds about 600 miles to the Grand Trunk system.

Toledo, Ann Arbor & North Michigan.—It is reported that the Cadillac extension will be pushed through to Lake Michigan with the opening of the season.

Providence & Worcester.—The report to the annual meeting shows the following:

Gross receipts for the year ending Sept. 30, 1887	$1,270,828.29
Gross receipts for the year ending Sept. 30, 1886	1,245,711.46
Increase in receipts this year over last	$25,116.83
Total expenses, including taxes, for the year ending Sept. 30, 1887	$831,850.93
Total expenses, including taxes, for the year ending Sept. 30, 1886	874,661.75
Decrease in expenses this year	$42,810.82

Ohio & Northwestern.—It is reported that this company intends to own a line from Portsmouth, O., to Pound Gap, Ky. The Eastern Kentucky Railroad will probably be absorbed.

New Projects and Surveys.

Buffalo & Williamsville.—

Room 14, American Building,
BUFFALO, N. Y., Feb. 6, 1888.

EDITOR ENGINEERING NEWS:

Four lines were surveyed for the Buffalo & Williamsville Railroad in the summer of 1886. The road will run from Buffalo *via* Cheektowaga, and Amherst to Williamsville, 10 miles, and the survey shows light work and easy grades, with about three-quarters of a mile of trestle work. About $100,000 has been subscribed to the stock, to be paid in installments as called for. A large portion of the right of way has been donated, and contracts will probably be let during the coming spring, the whole line to be completed in 90 days from date of contract. JASPER S. YOUNGS, of Buffalo, is Chief Engineer. I understand through the newspapers of the city that another company has been formed, under the title of the Williamsville & Buffalo Railroad company, in the interest of some land speculators, to build a line over a portion of our selected route, and to make connections with the Lackawanna line at or near its crossing at Main street, claiming that the proposed line will be some two or three miles less distance. In this company they have six or seven men who are stockholders in our company, for the purpose of creating the impression, I suppose, that the original Buffalo & Williamsville project has been abandoned, which is not the fact.

J. S. BUELL, *President.*

Chicago, Lodi & Southwestern.—Incorporated in Indiana to build a railroad from Covington *via* Lodi to Terre Haute, 54 miles, with a branch from Lodi to Brazil, 36 miles. THOS. N. RICE, of Rockville, is President; OTTO GRESHAM, of Indianapolis, is Secretary and Treasurer.

Seymour & Southwestern.—The preliminary survey of this Indiana line from Seymour to Jasper has been completed. F. M. SWOPE, of Seymour is President.

Prattsburg.—This short road near Bath, N. Y., is to be built this spring. C. M. RENCHAN, of Bath, is Superintendent.

Rochester & Honeoye Valley.—

KINGSTON, N. Y., Feb. 3, 1888.

EDITOR ENGINEERING NEWS:

This line is to run from Rochester, N. Y., direct to Honeoye Falls, about 16½ miles. Surveys will be made as soon as weather will permit, and contracts will be let as soon as frost is out of the ground. H. D. MCNAUGHTON, of Rochester is interested in the enterprise. No president has been elected yet.

A. GRANT CHILDS, *Chief Engineer.*

Maine Shore Line.—It is reported that this line from Hancock to the St. Croix river, about 115 miles, which was surveyed some time ago, will be built the coming season. The project is backed by the Maine Central Company.

Zanesville, Newcomerstown & Cleveland.—This new Ohio company has made a contract with the Baltimore & Ohio road for an interchange of traffic at Zanesville, and a provisional guarantee of its bonds. It has also made a contract with the Valley railway with which it will connect at Valley junction or Sandyville, thus giving a through line from Cleveland to Zanesville. The company has also secured extensive terminals at Zanesville, and most of the right of way for its road. WILLIS BAILEY is President.

New York & Ohio.—Incorporated in Ohio by DAVID M. YEOMANS and others, to build a railway through Trumbull, Geauga, Portage and Summit Counties. Capital stock $1,000,000.

Delphos & Northwestern.—Organized at Delphos, O., capital stock, $50,000.

Toledo & Indianapolis.—A press dispatch says that Col. J. H. SHINN of Willshire, O., is interesting capitalists in the construction of a railway between these cities to run *via* Delphos and Decatur.

SOUTHERN.

Existing Roads.

Chesapeake & Ohio.—The very gratifying news was announced this week that this company is to be reorganized and taken out of the Receiver's hands at an early date and placed under the management of President M. E. INGALLS of the Cincinnati, Indianapolis, St. Louis & Chicago. The work which Mr. INGALLS has done in putting the Big Four system upon its feet, gives ample assurance that the owners of the Chesapeake & Ohio will have their interests well watched over if Mr. INGALLS has them in charge.

Georgia Pacific.—Surveys have been made for the extension across the State of Mississippi, *via* Mayhew, Starkville, Winona, and Greenwood. The total distance from Columbus to Johnsonville, the terminus of the Mississippi river division, is 134¼ miles.

Kansas City, Memphis & Birmingham.—The directors have decided to issue the entire amount of bonds authorized by the mortgage, $25,000 per mile, of which $600,000 are still to be issued. The funds will be principally used in the purchase of rolling stock.

Savannah, Griffin & North Alabama.—This road, the controlling interest in which is owned by the Central R. R. of Georgia, is to go into bankruptcy. The road will be sold in the spring and the company will be reorganized as an integral part of the Central system. The extension from Carrollton to Decatur, Ala., will probably be considered later.

Louisville & Nashville.—The Cumberland Gap extension has been opened for business from Corbin to Barbourville, 14 miles. On the Nashville, Florence & Sheffield extension the track is laid to Ironton and three fourths of the grading completed. The company has refused to renew its trackage contract permitting the Cincinnati Southern road to run over its tracks into Louisville. The latter company will enter the city over the Louisville Southern tracks as soon as they are ready.—Grading is in progress on the gap on the Pensacola & Selma division.—Vice-President SMITH writes to the Louisville *Courier-Journal* to explain the charges made by the Louisville Southern managers that the Louisville & Nashville company was trying to injure and defeat the former enterprise. He states that the L. & N. Co. as a large taxpayer, has done all in its power to defeat attempts of the new corporation to secure local aid of excessive amount, an act of self protection for which the L. & N. managers can hardly be blamed.

Gainesville & Dahlonega.—It is reported that the long delayed extension of this Georgia road is to be undertaken this spring.

East Tennessee, Virginia & Georgia.—It is said that a line will be built during the coming summer from Jesup, Ga., to Jacksonville, Fla.

New Projects and Surveys.

Scottsboro' & Huntersville.—Stock has been subscribed for this proposed railroad in Alabama, and surveys are to begin this month. J. S. JORDAN of Scottsboro' is interested.

Kingston & Emory Gap.—This projected Tennessee line is again under discussion. It is reported that EDWARD SHELLEY of Newbern, Va., is to form a company to build the line.

Birmingham, Mobile, & Navy Cove Harbor.—T. MCNULTA of Mobile, the projector of this road, proposes to run a branch to Pensacola, Fla., and has asked a grant of right of way and aid from that city.

Pensacola & Memphis.—The $100,000 asked of Pen-

sacola to aid the building of this road is nearly all raised and grading will begin very soon.

Chattanooga, Hiawassee & Southern.—The survey of this line was begun at Murphy, N. C., Oct. 21, and has just been completed to the Cincinnati Southern railroad, near Chattanooga, Tenn., 94 miles. The maximum grade is 70 ft. and the maximum curve 6°. There will be 7 tunnels on the line, the longest 2,200 ft. in length, and two bridges over the Hiawassee river of 300 and 600 ft. The survey was made by J. A. KELLY, of Jasper, Tenn. HENRY E. COLTON is President of the company.

Chicago & Atlantic.—Incorporated at Nashville, Tenn., by E. B. STAHLMAN, J. L. GAINES and others, of Nashville, to build a line from Cumberland Gap to the point where Clear Fork creek crosses the Tennessee and Kentucky State line.

Southern & Western Air Line.—The survey of this line from Shelby to Morgantown, N. C., has been completed, and the engineers are at work on the line from Morgantown to Cranberry.

THE NORTHWEST.

Existing Roads.

Elgin, Joliet & Eastern Indiana.—Track was laid in 1887 on this Illinois road from Kings Jct., Ill., toward Spaulding, 10 miles. The line is now under construction between Kings Jct. and Spaulding, 25 miles and from Joliet, Ill., to Hobart, Ind., 50 miles. The chief contractors are Louis M. Loss & Son and W. E. Dorrin & Co. There is 5200 ft. of bridging on the line. L. B. JACKSON, 510 Royal Ins. Building, Chicago, Ill., Chief Engineer, favors us with the above information.

Missouri Pacific.—The formal consolidation is announced of the Pacific Ry. Co., of Nebraska, which is building the line from Warwick, Kan., to Hastings, Neb. Rumors from various sources indicate that considerable work is being planned for next season to extend the Gould system, in the Northwest. Lines are projected from Hastings northwest *via* Kearny and Broken Bow to the Wyoming coal fields, also from Omaha north to Yankton, Dak.

St. Louis, Alton & Terre Haute.—The contract for completing the Chicago, St. Louis & Paducah Ry. to Metropolis, on the Ohio river opposite Paducah, Ky., has been let to N. W. Irish, of Carlyle, Ill., the contractor who built the first division of the line from Marion to New Burnside. Engineers are now at work completing the location, and grading will begin as soon as weather permits.

St. Paul, Minneapolis & Manitoba.—A Duluth press report states that the company has begun work clearing the right of way for the extension from Hinckley to Duluth and will let contracts at once.—— The following story we find in an exchange:

"The Chicago Burlington and Quincy, it is rumored again, has secured control of the Manitoba road. Should this prove true, after the Chicago, Burlington and Northern is taken in, it will become an enormous system, reaching from Chicago as far west as Montana."

The author of this piece of intelligence fails to inform us how "control" was secured. Those who know how little of the Manitoba's stock is within reach of speculators or would be controllers will smile at the above preposterous squib.

Duluth, South Shore & Atlantic.—A statement sent to us from the general offices of the company gives the mileage of track laid in 1887 as follows: Sault Junction to Sault Ste. Marie, 47 miles; Nestoria, Mich. to Iron River, Wis., 165 miles. A branch has also been located to L'Anse. A large addition to the rolling stock is to be made in the spring. The company is negotiating with the Baldwin Works for 30 locomotives and expects a heavy ore traffic during the coming season.

Red River Valley.—The Manitobans are improving their time during the winter months by vigorous political squabbles, the chief bone of contention being the subject of railway monopoly. A Winnipeg press dispatch of Feb. 3, sets forth the distress which the farmers of the province are suffering from the inability to ship their wheat. The Canadian Pacific is said to be totally unable to handle the wheat crop; 1100 cars are now delayed along the line between Winnipeg and Port Arthur, and much of the wheat is spoiling from delay and exposure to weather. There can be little doubt that the early result of the extended agitation on the subject will be the completion of the Red River Valley Ry. and other competing lines to the American boundary.

Manitoba & Northwestern.—

PORTAGE LA PRAIRIE, Manitoba, Jan. 31, 1888.

EDITOR ENGINEERING NEWS:

No track was laid on extensions of the Manitoba & Northwestern Railway during 1887. The line is now in process of construction from Langenburgh to Prince Albert, N. W. T., 269 miles. The Saskatcheswan & Western Ry. is under survey from Rapid City to the east bank of the Assinboine river, 50 miles.

GEO. W. WEBSTER, *Chief Engineer.*

Central Iowa.—This line, extending from Keithsburg to Peoria, Ill., 90 miles and to Marshalltown, Ia., with branches, 395 miles, will be sold at Chicago on March 17. The company is being reorganized and the lines will form part of the Chicago St. Paul & Kansas City system.

New Projects and Surveys.

Springfield & Southern.—Recent reports state that a new line will be surveyed in the spring by this Illinois company.

Norfolk & Yankton.—A project is on foot at Norfolk, Neb., to build a road to Yankton, Dak. The citizens propose to secure right of way and local aid and locate the line, and induce the Union Pacific to build and operate it.

Omaha, Yankton & Northwestern.—This new Nebraska company, noted in our issue of Jan. 28, has asked $300,000 aid from Douglas county.

Winona & Southwestern.—The corps of surveyors who have been working on the proposed line of this road in Iowa have returned to Winona and as soon as weather permits will begin work on a line from Winona northwest to Rhinelander, Wis.

THE SOUTHWEST.

Existing Roads.

Texas, Sabine Valley & Northwestern.—

LONGVIEW, Tex., Feb. 4, 1888.

EDITOR ENGINEERING NEWS:

We are now running trains as far as Beckville, 28.45 miles from Longview, and laying track as fast as the weather will permit. Expect to reach Carthage, 10 miles farther by March 1. Will then suspend construction until line can be surveyed to a connection with the Houston, East & West Texas, 17 miles south of Carthage and with the Marshall, Paris & Northwestern, 12 miles north of Longview, construction on which sections will be resumed before the winter of 1888.

RICHARD J. EVANS, *General Manager.*

St. Louis, Arkansas & Texas.—The Corsicana and Hillsboro extension is open for business. The Fort Worth extension is completed to Grapevine and will reach Fort Worth by Feb. 25. Press reports state that the company will soon begin work on lines from Sherman to Abilene and McGregor to Austin.

Central Missouri.—At a recent meeting of the directors, it is reported that arrangements were made for pushing construction east and west from St. Charles as soon as the season opens. A survey has just been made through Boone, Howard and Callaway counties, the line running *via* Fulton, Columbia & Fayette.

Chicago, Rock Island & Pacific.—The committee headed by Ex. Lieut. Governor WHEELER, which has been obtaining subsidies and rights-of-way as an inducement to the Rock Island to build across the western part of the State, has now obtained promises of $275,000 local aid besides right-of-way and depot grounds through seven counties.

Atchison, Topeka & Santa Fé.—The St. Joseph & St Louis road is now operated as a part of the Santa Fé system, through trains running without change of crews from Atchison, Kan., to Lexington, Mo.—— Foreign advices state that Santa Fé securities are soon to be listed on the London stock exchange.

Des Moines & Kansas City.—A force is at work putting in steel rails on this road, and it is stated that the extension from Osceola, Mo., will be undertaken at once.

Denison, Bonham & New Orleans.—At a stockholders meeting at Denison, Feb. 2, it was voted to bond the road for $18,000 per mile, and make arrangements to push construction at once.

St. Louis & San Francisco.—It is reported that the company is trying to secure local aid for a proposed extension from Paris, Tex., to Sherman.

New Projects and Surveys.

St. Paul, Alexandria, Jennings, Lake Arthur & Gulf.—The stockholders of this company held a meeting at Jennings, La., January 28, and elected Col. E. R. SHANKLAND of Jennings, President.

Kansas City, Watkins & Gulf.—This company, which was incorporated in Louisiana, last July, has filed a charter in Kansas by which its proposed route is outlined for a distance of 550 miles from the Louisiana State line. J. B. WATKINS of Lawrence, Kan., is one of the incorporators.

Waco & Brazos.—Incorporated in Texas to build a railroad from Waco to Cameron, Milan County. WM. CAMERON is President. The principal office is to be at Waco.

Galveston Jetty.—Incorporated at Galveston, Tex., by A. M. SHANNON and others of Galveston, and B. F. FLANDERS of New Orleans, to build a railroad 15 miles in length "from the city, on the eastern shore, down to the jetty and on the same and back to the city on the west."

Omaha, Horace & Southwestern.—Incorporated in Kansas with a capital stock of $6,000,000 to build a 250 mile railroad, by E. D. HOLBROOK of Wichita, H. E. WOODBURY of Burlington, Vt., and others.

Lincoln, Colorado & Western.—Incorporated in the Union Pacific interest by A. F. WILLIAMS, H. P. DILLON and others of Topeka, to build from Plainville to the west line of the State 150 miles.

Kansas City, Argentine & Suburban.—Incorporated by NICHOLAS MCALPINE, CHAS. C. ADAMS and others of Kansas City to build a suburban dummy line 40 miles in length.

Kansas City & Bonner Springs.—Incorporated to build a dummy railroad from Kansas City *via* Armourdale to Bonner Springs, 15 miles. W. A. SIMPSON, of Kansas City, is President.

Houston, Central Arkansas & Northern.—

LITTLE ROCK, Ark., Feb. 4, 1888.

EDITOR ENGINEERING NEWS:

Our road has been surveyed from Pine Bluff, Ark., to Alexandria, La., and a preliminary survey is now in progress from Alexandria to Houston, Tex., making a total distance of 331 miles. Right-of-way is now being secured, and contracts will probably be let early in the spring. W. A. BRIGHT, of Little Rock, Ark., is President, and JAS. CONVERSE, San Antonio, Tex., is Chief Engineer.

A. W. FILES.

Denison & Sherman.

DENISON, Tex., Feb. 4, 1888.

EDITOR ENGINEERING NEWS:

The Denison & Sherman Ry. is now being surveyed from Denison to Sherman, 10 miles. Right-of-way is being secured and contracts will be let within 60 days, the road to be open for traffic by Oct. 1, 1888. The building of this road will allow the Denison & Washita Valley Ry. to connect with the St. Louis, Arkansas & Texas and the Texas & Pacific roads. The Denison & Washita Valley Ry. has been completed to Red river, and has been surveyed and located to the coal fields near Lehigh, I. T. It is intended to extend the road to Fort Smith, Ark. W. B. MUNSON is President of the Denison & Sherman Ry., and S. W. LEE is Chief Engineer; JOHN SCULLIN is President of the Denison & Washita Valley Co.

EDWARD PERRY, *Secretary* D. & W. V. Ry. Co.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Chicago, Rock Island & Pacific.—The Chicago, Rock Island & Colorado Railway company has been incorporated by R. R. CABLE, H. H. PORTER and others to build from the Kansas State line to Colorado Springs with branches to Pueblo and Denver. It will not suit Denver people very well if that city is not to be on the main line. Recent rumors state that the Rock Island company is the power behind the throne which has pushed through the Colorado Midland and that this is the reason why the Rock Island's main line is to go to Colorado Springs instead of to Denver.

Colorado Midland.—The Board of Trade of Leadville, Col., have voted to patronize the Rio Grande only and virtually boycott the Midland.——The new bridge at Aspenis completed and trains are now running into the town.

Southern Pacific.—The company is negotiating for the franchise of the San Diego & Cayamaca and San Diego & Elsinore companies.——About 20 miles of grading are completed on the extension in the San Joaquin Valley and tracklaying is to begin there soon.

Northern Pacific.—The January earnings of the system were $571,420, an increase of $64,966. The total mileage operated during the month was 384 miles above that operated in January, 1887.—The Cascade tunnel is progressing at the rate of about 15 ft. per day. The east heading is in 3,891 ft. and the west heading 4,103 ft. leaving 1,856 ft. to be driven.——A branch is projected from Sprague, W. Ter., to Salmon City, Idaho.

Los Angeles, Long Beach & Ocean.—This road is in the interest of the Santa Fé. The line has been located from Los Angeles to Long Beach, 24 miles, and grading is in progress. So says a contemporary.

Chicago, Burlington & Quincy.—It is reported that the company is securing right of way and town sites along a line from Riverton, Neb., across northwestern Kansas to Trinidad, Col.

Denver, Texas & Gulf.—At the annual meeting in Denver, Col., JOHN EVANS was elected President and C. F. MEEK, General Manager. The city of Denver is preparing for a grand celebration in March over the completion of this line.

Denver & Rio Grande.—The laying of the third rail from Pueblo to Trinidad is nearly completed. Reports state that grading has already begun on the extension from Glenwood Springs to Salt Lake City, a statement which is probably a little premature. There is no doubt however, that if things turn out as may be reasonably expected, the line will be pushed through this season. We comment more fully on this enterprise elsewhere.

New Projects and Surveys.

Rio Grande & Utah.—The people of Albuquerque, N. M, are disgusted over the fact that this road is to start from Algodones, 12 miles above Albuquerque. We comment more fully on this interesting enterprise in another column.

Tacoma Southern.—This line has been surveyed from Orting on the Northern Pacific up the Nisqually valley about 30 miles. The headquarters of the company are at Tacoma.

Oakland, Alameda & Laundry Farm.—This projected five mile road at Oakland, Cal., originated by J. H. WOODWARD, agent of the Wabash, has been turned over to H. E. DREW of Indiana who proposes to build the line at once.

Palmdale.—Incorporated by F. M. BUTLER of Oakland and others to build a branch to the Southern Pacific 6¼ miles in length from Seven Palms, San Diego county.